EDUCATION: THEORY & PRACTICE

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RECAPITULATION AND EDUCATION.[1] (Ped. Sem. Oct. 19

By CEPHAS GUILLET.

> "Do not train boys to learning by force or harshness; but direct them to it by what amuses their minds, so that you may be the better able to discover with accuracy the peculiar bent of the genius of each."—*Plato.*

CHAPTER I.

COMPARATIVE MORPHOGENESIS.

It is widely held by morphologists that the chief ontogenetic stages discovered by embryology tally more or less closely with the chief phylogenetic types revealed by the study of paleontology and comparative anatomy. It is the purpose of this chapter briefly to indicate some of the embryological evidence upon which this conclusion is based. A table is appended showing the parallel phylogenetic and ontogenetic development of man, so far as ascertained.

The first stage at which we know any animal is that of a single cell, represented phylogenetically by the protozoan. As to the first stages through which the human ovum passes, we have no direct evidence, no human embryo being known less than about two weeks old. But as the history of all other vertebrates is much the same during the first stages of development, and the earliest known human embryos are almost indistinguishable from those of the other vertebrates at certain periods, and especially of the higher vertebrates, we are not likely to go far astray in supplying the missing stages from them.

"All metazoa," says Balfour,[2] "originate from the coalescence of two cells. The coalesced product of these cells—the fertilized ovum—then undergoes a process known as segmentation, in the course of which it becomes divided in typical cases into a number of uniform cells." The ovum and sper-

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[1] This article forms the concluding part of a work on Recapitulation, most of which was written by the writer while a fellow at Clark University. His heartiest thanks are due to the staff of the Psychological Department of that university, and particularly to President G. Stanley Hall, who suggested the subject, and under whose guidance and stimulating companionship the work was done.

[2] Balfour, F. M.: A Treatise on Comparative Embryology, 1885. This is true except in case of parthenogenetic development.

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metozoon Balfour regards as representing phylogenetically two physiologically differentiated forms of a protozoan; their coalescence was equivalent to conjugation: the subsequent segmentation of the fertilized ovum was the multiplication by division of the organism resulting from the conjugation; the resulting organisms remaining, however, united to form a fresh organism in a higher state of aggregation.

As a rule, a cavity soon appears in the center of the round mass of cells, which is then called a blastula. In the case of some lower aquatic animals, the blastulæ, says Hertwig, abandon the egg-envelopes, and, since their cylindrical cells develop cilia at the surface, swim about with rotary motion in the water as ciliate spheres or blastospheres.

Now by unequal growth and division of labor, two differentiated layers of cells always result in the form of a gastrula, if we follow Haeckel, Hertwig and others, or of a diblastula, following Lankester. According to the former, the simplest and most primitive form is that of the gastrula, formed by simple invagination; while, according to Lankester, it is that of the planula, or diblastula, formed by delamination, the mouth being secondarily acquired. The result, however, is the same. Balfour, while finding it impossible to decide which of these processes reproduces the mode of passage between the protozoa and the ancestral two-layered metozoa, considers the fact well established that the gastrula, however involved, was a ev
primitive form of the metozoa; since this conclusion is founded upon the actual existence of adult gastrula forms, namely, hydrozoa, independently of their occurrence in development. The cavity of the gastrula, says Hertwig, is the primitive intestine (archenteron) opening to the outside through the primitive mouth (blastopore), which in vertebrated animals is only an evanescent structure. And so Balfour thinks it probable we may assert that the gastrula reproduces, with more or less fidelity, a stage in the evolution of the metozoa, permanent in the simpler hydrozoa, during which the organism was provided with (1) a fully developed digestive cavity, lined by the hypoblast, with digestive and assimilative functions, (2) an oral opening, and (3) a superficial epiblast (or ectoderm). Moreover, Hertwig says, that "larval forms at this stage in the case of many cœlenterata, echinodermata, vermes and brachiopoda, quit the egg-envelope to swim about in the water by means of their cilia; and they can now take nutritive substances—small infusoria, algae or remnants of larger animals—through the primitive mouth into the digestive cavity, and make use of them in the future growth of their bodies. Likewise, the substances which are not serviceable, because indigestible, are ejected from the body through the same orifice. In

the case of the higher animals, the ingestion of food is not only impossible at this time, but also superfluous, because the egg and the embryonic cells arising from it still contain yolk-granules, which are gradually consumed."

Without going into details regarding the formation of further layers, etc., we next find the embryo in an elongated bilateral stage. "Radial symmetry," says Marshall,[1] "seen in its most typical form in the gastrula, is confined to aquatic forms." From the changes that take place in turbellarian worms Marshall is led to infer "that bilateral animals are descended from radiate ancestors, that bilateral symmetry is something additional to and imposed on the radiate symmetry, and that this further modification is a direct consequence of the animals having exchanged their pelagic free-swimming habits for crawling ones; a change that would at once lead to the establishment of a difference, both structural and physiological, between the ventral and oral surface along which locomotion is effected and the opposite or dorsal surface; while the further differentiation between anterior and posterior ends would very soon follow as a necessary consequence of this same crawling habit."

Hertwig, describing the external form the embryo now assumes, says that "the embryonic area by means of the folding of its flattened layers into tubes forms the elongated fish-like body which all vertebrates at first exhibit." This fish-like or worm-like body comes to possess at about two weeks an intestinal canal with one anterior and one posterior opening in the ventral side; a neural tube (the rudiment of the central nervous system) which at first opens into the intestinal canal and soon becomes thickened at the anterior end; and a round chordal rod (found permanent in amphioxus) being the *Anlage* of the vertebral column. Several somites or myotomes are also visible and a rudimentary heart is present, while branchial clefts soon also appear. There is no trace of limbs during the first three weeks.

There is great difference of opinion among embryologists as to the significance of these changes. Dohrn interprets them as suggesting that an annelid form is a remote ancestor of the vertebrates, of which latter the ascidians are a degenerate offshoot. Semper, Poli and Minot support the annelid hypothesis; the last-named, however, regards the ascidians and amphioxus as derived from the annelids, not through the vertebrates, but through the hypothetical "atriozoa." K~~l~~owalewsky considers the ascidians in the direct line of descent with the amphioxus. Haeckel[2] holds that the flatworms, the ascidians (which he so

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[1] A. M. Marshall: Biological Lectures and Addresses, 1894.

[2] Ernst Haeckel: "Anthropogenie oder Entwickelungsgeschichte des Menschen, 4te. Aufgabe, 1891.

classes among the worms) and amphioxus are here suggested in order. Brooks[1] agrees only ~~as~~ far as to regard the appendicularia (an ascidian) as the nearest living representative of the common ancestor of ascidians and chordates. Balfour concludes that "the ancestral forms of the chordata must be supposed to have had a notochord as their sole axial skeleton, a ventral mouth, surrounded by suctorial structures, and very numerous gill-slits," and he regards amphioxus and the ascidians as degenerate offshoots of this stock. Finally Willey[2] comes to the following conclusion: "The proximate ancestor of the vertebrates was a free-swimming animal intermediate in organization between an ascidian tadpole and amphioxus, possessing the dorsal mouth, hypophysis, and restricted notochord of the former, and the myotomes, cœlomic epithelium, and straight alimentary canal of the latter. The ultimate or primordial ancestor of the vertebrates would, on the contrary, be a worm-like animal, whose organization was approximately on a level with that of the bilateral ancestors of the echinoderms."

If Brooks's view is correct, the early phylogenetic stages of development after our pelagic ancestors took to the sea-bottom were rapid. According to Fritz Müller, forms rapidly changing to other forms are less deeply imprinted in the ontogeny than those which lasted long. Besides, as Balfour points out, characters of any stage of the development which are of functional importance during a free but not during a fœtal existence will tend to disappear. It is no wonder, then, that the embryological history of vertebrates is very rapid and cursory in the early stages.

The next stage in the embryonic development of the vertebrates all embryologists agree in calling the fish stage, and of this we have very satisfactory evidence from the human embryo of about three weeks. The head is somewhat folded off from the body, and three swellings are present, representing fore, mid and hind brain; the gill-clefts are retained; rudiments of auditory, olfactory and visual organs appear as invaginations; four undifferentiated buds appear for limbs; a short tail is present, a bladder-like rudiment of lungs and rudiments of the liver and the other important internal organs. What we have is merely a higher vertebrated animal. Von Baer, Agassiz, Haeckel, Darwin, Huxley, Parker, Marshall, all agree as to the striking resemblance between the embryos of the mammal (including man), the reptile, the bird and the fish at this stage, the conclusion drawn ever since Darwin's "Origin of Species" being that the progenitor of the mammal, bird, reptile and fish had in its adult state branchiæ, swim-bladder, four fin-like limbs and a tail, all fitted for aquatic life. Parker demonstrates such a relationship by a minute comparison of the mammalian embryonic skull and face with those of the shark and skate. According to Minot it is not until the fortieth day that the form is distinctly human.

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[1] W. K. Brooks: "The Genus Salpa," 1893.

[2] A. Willey: "Amphioxus and the Ancestry of the Vertebrates," 1894.

The embryo now begins to lose the gills—which are converted into other organs—and develops lungs out of the pulmonary groove, by the lower end widening out and dividing into two forks or pouches; the branching of the lungs begins at about four weeks. The fin-like rudiments of limbs develop joints and become pentadactyl, but the fingers and toes are not separate from one another until the latter part of second month. This transition stage recalls the amphibia. "The primitive position of the limbs," says Minot,[1] "is at right angles to the body in a plane parallel with the longitudinal body-axis. The first change is the appearance of two bends which give the limb the position which is permanent in the amphibia;" and which is such that, "the ventral aspects of the forearms and lower legs come to look inwardly and their dorsal aspects outwardly, while the ventral aspects of the hands and feet look downward and their dorsal aspects upward. This change is obviously correlated with the change from aquatic to terrestrial life, and the consequent substitution of legs for fins." . . . . "The second step is the torsion of the limbs, which is similar in both pairs and occurs in all mammalia, the result of which is that the digits point headward, the first digit being in both hind and fore limbs turned toward the median line. This is the arrangement which is permanent n the reptilia and in the lower mammalia." This torsion takes place at the shoulder and hip. "The third change is the torsion of the upper arm by which the distal end of the humerus is turned over through an angle in man of nearly or quite 180°; by this torsion the head of the radius, which before the change was on the inner side of the arm, is brought across in front of the ulna to the outer side, with the result that if the hand is kept in its primitive position, palm down, the forearm is twisted in the reverse direction to the upper arm; this third change is accompanied by accessory modifications in the joints and muscles by which the radius becomes so movable that it can be employed to turn the hand with the palm either up (supination) or down (pronation.)" Rudiments of nails appear at the ends of the fingers and toes in the fœtus of 75 days; they are afterwards pushed up to the dorsal side. At four months, the spine of the fœtus still describes but a single, dorsally directed curve like that of the quadruped. In the fourth or fifth month, according to Wiedersheim,[1] the human embryo has a distinct *stratum corneum* with an epidermal layer outside it, which corresponds with the epitrichium of reptiles. This epitrichium layer appears in the third month, becomes horny and finally disappears from most parts of the body after the sixth month of embryonic life. Rudiments of hair appear at about three months; at the end of the fifth month the hairs begin to break through the integument, and in the sixth month the whole body of the embryo, except the volar and plantar surfaces of the hands and feet, the red edges of the lips and two or three other spots, is covered with abundant soft woolly hair, the "lanugo," which is normally shed before birth or immediately after, except on the face, and gradually replaced in certain parts by the coarse hairs characteristic of man. In this lanugo stage the embryo evidently repeats the lower mammalian stage, further evidence being furnished by the formation of mammary pits as in the monotremes, which give place to nipples, these being found alike in marsupials, lemurs, apes and man. The nipple does not usually become protuberant until after birth.

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[1] C. S. Minot: "Human Embryology," New York, 1892, p. 452.

The child at birth is not yet structurally a human; he is even behind the ape in some important respects. For some time after its birth, to quote Turner,[2] the infant retains the quadrupedal character of the spinal curve in the dorso-lumbar region, and as it acquires nervous and muscular power and capability of independent movement, its mode of progression in the early months by creeping on hands and knees approximates to that of the quadruped. It is only after it has attained the age of from a year to 16 months that it can erect its trunk, completely extend the hip and knee joints (which even the Anthropoid ape cannot do) and draw the leg into line with the thigh so as to form a column of support, which enables it to stand and move about on two feet. The lumbar convexity of the chimpanzee at two years is greater than that of a child of the same age. The production of the cervical convexity precedes the formation of the lumbar curve, for an infant can raise its head and take notice of surrounding objects months before it can stand upon its feet.

Co-ordinate with the curvature of the spinal column, another great structural difference between man and the other mammals is found in the hand, which, from being a locomotive organ in mammals, and in addition, a prehensile organ in the apes, has become in man a highly developed manipulative organ. Baker, Turner, and others, have demonstrated the adaptive structure of the human hand, which is capable not only, like the ape's hand, of grasping cylindrical objects, but also flat and spherical objects, and not only of opposing the thumb to the rest of the fingers in seizing an object, but also of opposing the thumb to each finger, and making delicate adjustments, while the fingers may be used independently of each other with considerable facility. This increased mobility and variety of action is brought about in two ways: first, by reducing the ape-muscles (especially the *palmaris longus*) used to assist prolonged grasp, they being no longer necessary to an organ meant for delicate work requiring constant re-adjustment; and second, by the development of new elements, and in particular a special flexor muscle for the thumb, which has been split off from the fibers of the deep flexor that bends the terminal joints of the fingers. In most apes the two form a single muscle, and in all, the thumb is but feebly developed. This special flexor muscle (the *opponens pollicis*) through its insertion into the shaft of the metacarpal bone of the thumb, draws the entire digit across the surface of the palm.

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[1] R. Wiedersheim: "The Structure of Man" (English edition), London, 1895, p. 5.

[2] Sir Wm. Turner: "Some Distinctive Characters of Human Structure," Nature, 1897, pp. 425–435.

The orang, according to Turner, and the gibbon, according to Baker, have something corresponding to an imperfect opponens muscle in the foot also, but this is lacking in the other anthropoids, which are dependent, for the opposition of the great toe, upon the adductor and short flexor muscles. In the human foot (unlike the ape's) the hallux is tied to the second toe by a continuation of the same transverse connecting band which ties the smaller toes together; there is also no *opponens hallucis*, and the short flexor of the great toe is, in relation to the size of that digit, comparatively feeble, so that no special provision is made for a movement of opposition. The reason for this is that the human foot, relegating to the hand all functions of prehension, has taken over the whole task of locomotion, for which not precision and delicacy, but size, strength and firmness are required. The increased size of the muscular calf of the leg in man is another adaptation to the exclusive use of the feet as locomotive organs. The condition of the foot in the fœtus, and also for several weeks after birth, approaches that of the ape's, the joints being so arranged that the sole can be easily turned inward, presenting the "arboreal twist" of which Huxley used to speak.

To return to the hand, the fingers have in man each two separate flexor tendons that can act to a certain extent independently. To ensure their independence they are, at the wrist, says Baker, enclosed in a remarkable tubular conduit or subway, formed by soldering the palma fascia to the wrist-bones. This destroys any effective action on the fingers of the *palmaris* *longus*, which thus, from being a flexor of all the fingers together, becomes a flexor of the wrist. Baker calls attention to the interesting fact that in embryonic life all the muscles of the anterior part of the forearm are united in what is termed the pronato-flexor mass, recalling the original condition of musculature in the earliest animals possessing limbs.

The progressive development of the hand as a manipulative organ has brought with it changes in the arm and shoulders which are described by Baker[1] as follows: "Embryology teaches, that the humerus was formerly set so that the hollow of the elbow looked inward rather than forward, and it seems, therefore, that, as the functions of the limb became more various, the lower end of the bone gradually twisted outward around the long axis until its diameter described a considerable arc. This turned the hand with the palm to the front, extended its range and adapted it for a wider usefulness. As the torsion increased some provision became necessary for carrying the hand easily across the body to the mouth. This was effected by the inclination of the trochlear surface of the elbow-joint." Again, "many movements of the arm in man are produced by muscles acting upon the shoulder-blade or scapula. As the hand was turned outward and a wider range given, these movements increased in extent and importance, and the scapula accordingly widened out at its vertebral border in order to give a more extensive attachment for muscles. In order accurately to estimate this change, the ratio of the breadth to the length of the scapula is taken. This ratio, called the scapular index, is highest among the white races, less in the infant; in negroes and in Australians, and still less in Anthropoid apes. It is significant also that the vertebral border of the scapula is the last to form in the fœtus. We have, therefore, three modifications—the torsion of the humerus, the inclination of its trochlear surface, and the scapular index—all depending upon each other, all varying together *pari passu*, and all showing a progressive development both in the individual and the race."

Structural evolution has, however, by no means reached the highest possible point. While the erect posture itself is now fully attained by the white races, the adaptation to the erect posture is as yet far from complete. The pelvis, and the digestive and vascular systems offer abundant evidence of this fact.

It is an interesting fact that the fœtus in at least the early months of its life is a cold-blooded animal, and only gradually does it become warm-blooded[2]—in this respect also repeating the racial history. The greatest care must be taken to keep prematurely-born children warm. The axillary temperature of a seven months child, says White, was 89.6° F; and even at birth at full time the temperature is only 94.5° F. Moreover the temperature of children, especially very young children, is not nearly so constant as that of adults.

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[1] F. Baker: "The Ascent of Man," Proc. Am. Ass. Adv. Sci., 1890, pp. 351-373.

[2] W. H. White: "Explanation of the Evolution of Warm-blooded Vertebrates," J. Anat. Phys., XXV (1891), pp. 374-385.

Very early in embryonic life (about the second week) a neural groove (which soon closes into a tube) forms out of the dorsal ectoderm or outer layer of cells; just as in early phylogenetic development the central nervous system became differentiated from the epidermis and travelled inwards, retaining its connection with the sense-organs (of smell and sight and hearing) which gradually evolve from the epidermis, being at first, both phylogenetically and ontogenetically, simple invaginations or pits.[1] Invagination is, however, preceded by exvagination in the case of the vertebrate retina,[2] though not in the case of the lens, In the central nervous system there next follows, both ontogenetically and phylogenetically, the differentiation of the nervous matter into an external layer of fibers (white) and an inner layer of cells (gray). The nervous axis is divided into brain and spinal cord, and at about three weeks the brain in turn divides into two parts and then, by division of the foremost part, into 3 lobes, the fore,- mid- and hind-brain. These contain the principal centers for the co-ordination of sensation and movement. The hind-brain becomes converted into the cerebellum, pons and medulla; the mid-brain into the optic lobes (corpora quadrigemina) and the cruri cerebri. The mid-brain, Minot says, grows more slowly in mammals than in lower vertebrates, its importance diminishing as we ascend the vertebrate series; while the cerebral hemispheres grow more rapidly than any other part of the brain. These important organs, according to Minot, grow out of the fore-brain, beginning already in the third week, and growing out in front and then extending back over the fore-brain. The two lateral optic vesicles are already demarcated from the fore-brain. While the hemispheres are expanding, the olfactory plate acquires a more marked differentiation beneath them and shows traces of division into a dorsal or anterior and a ventral or posterior lobe.

Through the researches of Flechsig[3] on the progressive medullation of the nerve fibers, we now know that, while the spinal cord is functional quite early in fœtal development, namely, about the fifth month, and the lower parts of the brain have completed their development already at birth, the cerebral hemispheres, on the other hand, are at birth capable of functioning only to a limited extent, a few nerve-paths mediating sensations in certain of the sensory areas, while the association fibers between the various sensory areas of the cortex do not begin to function until a month after birth. The afferent or sensory fibers are always functional before the efferent or motor fibers in the cerebrum, while the reverse is the case in the spinal cord and medulla. The first sensory fibers to become mature (from the beginning of the ninth fœtal month on) are those that conduct organic sensations, namely, kinæsthetic sensations and sensations of hunger, thirst, discomfort, and also touch and temperature impressions from the skin. Part of the organic sensations are possibly mediated exclusively by lower parts of the brain, and in particular the cerebellum, which registers many kinæsthetic sensations, and the medulla which registers hunger, thirst and discomfort feelings. A monstrosity born with only the lower parts of the brain up to and including the lower part of the corpora quadrigemina yet gave forth many signs of discomfort. Its whimperings and the movements of the extremities became more vigorous when one pinched its skin. Children born before time cry out for the satisfaction of their bodily needs. Even expressions of pleasure or rather comfort are found in infants born at eight months, in whom the cerebral cortex shows nowhere any completely developed mature nerve-elements. About the end of the ninth month the olfactory tract contains medullary sheaths. The centers for taste are thought to be located either at the edge of the somæsthetic area or of the olfactory area. The optic nerve shows medullated fibers in the middle of the tenth month; but certain visual impressions are possible at nine months (birth). The fibers of the auditory tract are developed last of all the sensory nerves. The order of development of the sensations ontogenetically, therefore, is organic, tactile, chemical, visual and auditory, and this appears to be also the phylogenetic order. About a month after birth the association areas of the brain begin to become medullated (except the subangular gyrus which receives medullation earlier), but even at three months they are still very poor in medullation compared with the sensory-motor areas. But now numerous association fibers rapidly appear, starting from the other

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[1] *Cf.* F. M. Balfour: "Comparative Embryology," Vol. II.

[2] K. Schreiner: "Histologische Studien über die Augen der freilebenden marinen Borstenwürmer," Bergens Mus. Aarborg, 1897 (1898), 30 pp.

[3] Paul Flechsig: "Gehirn und Seele," 2nd ed., 1896; "Die Localization der geistigen Vorgänge insbesondere der Sinnesempfindungen des Menschen," 1896; "Ueber die Associationscentren des menschlichen Gehirns," Dritter internat. Kong. f. Psych. in München, 1896, pp. 49-68; Zur Anatomie des vorderen Sehhügels, des Cingulums, und der

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Acusticusbahn," Neur. Cent., 1897, pp. 290-295. Ireland gives a summary of the two first named works in Jour. Ment. Sci., 1898, XLIV, pp. 1-17.

THE EVOLUTION OF MAN

According to the evidence of Comparative Anatomy, Paleontology and Embryology.

CHIEF PHYLOGENETIC TYPES.	FIRST APPEARANCE IN GEOLOGICAL TIME.	CHIEF ONTOGENETIC STAGES.
		Human Stage.
Man	Quaternary	Erect posture and lumbar convexity of the spine—manipulative hand—articulation — large and highly plastic brain.
		Imperfect Hand Stage.
Primate	[1] Miocene (of Tertiary)	Grasping objects with opposition of thumb in 4th post-natal month—medullation rapidly extending in the association areas of the brain from 4th month on,—attempts to assume erect posture in latter part of first year.
Lemur	Eocene (of Tertiary)	
		Early Mammalian Stages.
Insectivore	Juras (of Secondary)	Formation of mammary pits about 3rd fœtal month, followed by nipples, which protrude about time of birth—larungo begins to form about 4th fœtal month, shed about time of birth—only 2 curves in the spine at birth—association areas of brain beginning to function about end of first post-natal month. la
Marsupial	Trias (of Secondary)	
Monotreme	[2] Trias (of Secondary)	
		Early Air-breathing Stages.
Reptile	Permian (of Primary)	Reptilian torsion of the limbs—fingers and toes free (towards end of 2nd month)—nails begin to form (middle of 3rd month)—Reptilian epitrichium well marked in 3rd month, later becomes horny—a single dorsally-directed curve in the spine.
Amphibian	Carboniferous (of Primary)	Lungs being developed; limbs differentiated into fore and hind, and becoming jointed, pentadactyl and webbed (about the 5th fœtal week).
		Water Vertebrate Stage.
Dipnoan	Upper Silurian (of Primordial)	
Selachian	Upper Silurian (of Primordial)	Gills, swim-bladder, fore- mid- and hind-brain, then 4 fin-like rudiments of limbs (at about 3 weeks).
or Ganoid	Lower Silurian (of Primordial)	
		Early Bilateral Stage.
Amphioxus	[3] Cambrian of Primordial	Bilateral form assumed—intestinal canal — myotomes — neural tube with thickened cephalic end—notochord (at about 2 weeks).
Ascidian (Appendicularia),		
or Worm (Annelid)	Lower Cambrian of Primordial,	
		Radiate Stage.
Cœlenterate (Hydrozoan)	Lower Cambrian of Primordial,	Radiate form—stomach and mouth (*gastrula*).
(Larval invertebrate)	Lower Cambrian of Primordial,	Cell colony (*blastula*).
		Unicellular Stage.
Protozoan	Archæan	A single cell.

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[1] Dr. Dubois has recently (1894) discovered in Pliocene volcanic deposits a new anthropoid form, which is described by O. C. Marsh as being "not human indeed, but in size, brain power, and erect posture, much nearer man than any animal hitherto discovered, living or extinct." Till this discovery no remains of apes had been found in deposits more recent than the Miocene. Others regard these remains as human.

[2] The Triassic Multituberculata are said to be intimately related to the existing Monotremata.

[3] C. D. Walcott concludes, from the finding of ichthyic fauna at the base of the Lower Silurian, that the differentiation of vertebrates and invertebrates must have begun in Cambrian time.

centers and gradually connecting all parts of the brain together. In this connection a fact mentioned by Baker is interesting, namely, that in monkeys and the inferior races the ossification of the sutures commences at the anterior part of the head, while in Europeans these sutures are the last to close. This would indicate a greater and longer continued increase of the frontal lobes of the brain, which form one of Flechsig's association areas. And, in fact, the association areas in man form much the larger part of the cortex, whilst among the other mammals only in the higher catarhines do the association spheres even equal the sensory spheres in superficial area. The lower apes, even the baboons, show only little developed association centers, and in the lowest orders of mammals there are no such centers clearly marked.

CHAPTER II.

COMPARATIVE PSYCHOGENESIS.

The progressive steps in the physical development having been indicated, a brief summary and comparison will now be attempted of the evolution, in the child and in its animal ancestry, of each of the great instincts of life.

Hunger.

The hunger instinct shows a gradual but continual progress phylogenetically from the generalized state of the amoeba by the differentiation and improvement of senses, prehensile, digestive and locomotive organs and nervous mechanism. As a rule the invertebrates feel about for their prey aided by the tactile and chemical senses, the fishes actively pursue it, aided chiefly by sight and smell, the amphibia and reptiles stalk it, while the mammals combine hunting and stalking, the apes using the most varied and intelligent methods of procuring their food, both animal and vegetable.

Hunger is the all-absorbing instinct of the new-born child as of the more primitive animals, and its manifestations increase in variety with the unfolding of the senses, the muscles and the nerves. Both phylogenetically and ontogenetically the tactile and chemical senses are the first to be actively employed. The amoeba engulfs almost anything and everything of a suitable size that it touches. Tactile and prehensile organs are found in multitudinous forms throughout the animal scale from the pseudopodia of the amoeba and the oral tentacles of the polyp to the long flexible sensitive fingers of the tarsius and the chimpanzee with which they search in holes and crannies for eggs, insects and other toothsome morsels. The child will grope about with head and hands and finally with the index finger alone. He will try to suck and swallow anything that touches the lips and cheek but soon begins the more active and successful digital explorations. The new-born child can distinguish between sweet and bitter tastes and soon learns the odor of milk. But, as with the animals so with the child, the chemical senses of taste and smell are not psychically distinct at first, and discriminability is slight. As the discriminability increases, the interest in new taste sensations becomes more marked; but the sense of smell never attains to that importance ontogenetically that it has phylogenetically, this sense being degenerate in man. The child of three months will try like the lower vertebrates to grasp objects with the mouth and chew them, while for the first year or so after he learns to grasp like the ape with the hand (several weeks later than with the mouth), everything that the hand seizes also goes to the mouth. L. Robinson[1] thinks that the infant's habit of picking up things and putting them into his mouth was at one time an important factor in determining survivorship. "In times of stress, when the hunters of the starving clan were scouring the country for prey, and the squaws were digging for roots in the forest, he busied himself in a profitable manner among the abundant debris on the floor of the cave, or experimented gastronomically with grubs, caterpillars, and other small deer, as he crept after his mother among the grass." This may account for the continuance of the habit into the second year. In the second month, if not earlier, the child begins to recognize food or the source of food by sight, a sense which, as in the animal scale, gradually becomes more and more important till the child like the ape depends mainly on its impressions in nutrition and forms many useful associations by its means. In the child's second and third years other interests rival and gradually subordinate those of taste, a process that takes place also in the animal series to a certain extent.

Self-Defence.

The skin of the new-born child like that of the very lowest animals is very sensitive to the contact of foreign bodies. The protozoan reacts to injurious stimuli by various contractile movements, such as shrinking, jerking back, and assuming a globular form, which presents the least possible surface to the injurious stimulus. Similar contractile phenomena in response to mechanical and thermal stimuli are observable in the newborn child, indeed in the fœtus. Fear in a rudimentary form seems to be an essential property of living matter. Consider the very words used to denote action in fear or expression of fear in all animals, and their connection with contractile phenomena of the skin and other parts of the body: *shrink*, *shudder*, *quake*, *quiver*, *twitch*, *writhe*, *palpitate*. G. S. Hall[1] is of opinion that the peculiar sensation induced by a minimal touch—what he calls knismesis—represents the generalized tactile sensations of primitive organisms, "the very oldest stratum of psychic life in the soul." There is considerable evidence that the skin of children during the first two years is much more sensitive than that of adults. On the other hand children during the first year seem to be less sensitive to pain than adults, which is probably paralleled by increasing sensitiveness to pain as the animal scale is ascended. The explanation is probably the same in both cases, viz., the relative lack of development of the nervous system in the more primitive and embryonic forms, which has as its concomitants imperfect powers of localization and concentration.

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[1] "The Primitive Child," N. A. Rev., 1894, Vol. CLIX, pp. 467-478.

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Muscular sensations, or sensations of position and movement probably come as early as tactile sensations, both phylogenetically and ontogenetically. The phenomenon of geotropism observed for example in the cœlenterate Beroë, and the function of equilibration mediated by muscle feeling and by the semicircular canals in vertebrates, are illustrations of the instinct to keep a certain fixed position relative to the center of gravity. All animals, naturally, must reckon with gravity and equilibration-organs are among the first sense-organs to be differentiated off from the general sensory surface. We find these first in the cœlenterates, but the cilia of many protozoa probably perform the same function as the sense-hairs of the otoliths or "statoliths," as Verworn prefers to call them. The existence of a fear of falling in the new-born child is evidenced by the discomfort he shows in certain positions, by his starts of fear when his equilibrium is suddenly disturbed and his signs of distress, in Robinson's experiments, when his grip begins to loosen. In the arboreal vertebrates, and especially the apes, which are continually confronted with the danger of falling, the instinctive dread of the same is very apparent in the caution which many of them exhibit in their climbing and leaping. The keen delight shown by children and apes when tossed up and caught is doubtless due to the presence of this spice of danger and fear. The new-born infant's capacity of supporting his own weight by holding on to a rod while his toes try to curl over anything graspable is interesting as the appearance at birth of a capacity formerly advantageous in enabling mother and infant the more readily to escape from their enemies. The flexed position of the thighs of new-born children and the position of the feet which Espinas noticed in the second week turned flatwise toward each other is interesting in this connection as well as the fact noticed by him in his child on the fifth day, viz., that while no noise awakened him, yet calls with lip sounds made him shut his eyes; which may be the rudiment of a former prompt reaction to the mother's warning cry.

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[1] *Am. Jour. Psy.*, 1897, IX, p. 12.

Sensibility to light is rare among the protozoa, but general among the metazoa. As a rule the lower animals prefer the dark, while the apes are almost without exception diurnal animals, and we have even some evidence that they are afraid of the dark. The child at first shuns strong light, but this, like many other early reactions, seems to be due rather to the delicate sensitiveness of the unaccustomed nerves than to a feeling of fear. He soon shows for it a strong interest, which seems very like fascination, due doubtless to the mixture of pain and consequent fear still present. This fascination for a bright light is quite prevalent among the vertebrated animals. Later on, some children show fear of the dark, but whether this is innate or due to suggestion does not appear.

The sense of hearing proper, appears to be developed late in the animal series, namely in the fishes, and even here but very imperfectly; but even lower metazoa can perceive shocks coming through a liquid or solid medium. The child also cannot hear for from one to seven days after birth, but during this time concussions seem to be perceived, as in the case of the fish, by organs other than the ears,—probably through the general sensory surface of the child's body. Loud noises have the effect of startling animals, causing them to twitch, shrink, etc., and the same is true of the new-born child. As soon as hearing proper developed, this sense appears to have been of use chiefly to warn of the approach of enemies. The amphibian, the reptile and the mammal, all show fear of unfamiliar sounds, a fear that is also generally intense in the child, especially during the first year.

The sudden appearance of an object startles a child sometimes as early as the second month. A sudden sight has the same effect on all vertebrates, and there are certain invertebrates that are startled by a sudden shadow or a flash of light. All vertebrates instinctively fear and avoid their enemies among the other animals. This may partly account for the presence of an instinctive fear commonly observed in little children, almost as soon as they can distinguish form,—of strangers, animals and objects which resemble animals such as fur, feathers, big teeth, machines, etc., especially if they move.

Fear of water is not observed phylogenetically till the apes, a few of which are unable to swim. Ontogenetically we have some doubtful early evidence of the fear of a touch of water but none of the sound and sight of it till the second year. This dread element has left a deep and lasting fear in the human organization which is readily accounted for by the fact that man has not been instinctively able to swim since the ape stage.

Caution and ingenuity in avoiding danger increase in variety and intelligence of manifestation alike phylogenetically from the water vertebrate stage on, and ontogenetically from the fourth month on. The child has already a little store of self-defensive associations by the time he is about a year old, when he begins also to use cunning in defending and aggrandizing himself. In this the eighteen months child, however, does not surpass the sly and watchful ape. There is no satisfactory evidence of a fear of death either in animals or in little children. There is some trace in the child's second year and later of an instinctive horror of uncleanness, which may be an inheritance from his animal and especially mammalian ancestry.

The home and migratory instincts, the instincts for seeking and retaining a congenial environment, are naturally possessed by all animals and also by the child from birth. Children get well orientated to their home surroundings by the latter part of the second year, at which time they begin to wander off into the streets, to the fields or to the water.

Play and Curiosity.

Animal play begins with seemingly aimless movements and antics. In the water-vertebrate stage a prominent direction given to play is hunting; while a new expression of well-being introduced with the fishes is the making of sounds. Curiosity is plainly exhibited by the fishes. The sports of the amphibia and reptiles—including their vocal exercises—are more diverse and their curiosity keener; and this development continues steadily in the highest order of animals, reaching its highest point in the restless and inquisitive apes.

The child's play begins with vague, tactile and muscular exercises of the limbs and features which are in constant movement. The slow rhythmical movements of flexion and extension of the fingers and the rotatory movements of the wrist common in the early months, Mumford regards as survivals of aquatic locomotion. In the second and third months movements of the trunk and head are prominent. The child tries to raise itself to a sitting posture at the end of the third month. In the third month, sometimes even in the second, begins random grasping at objects. The mouth is, however, the first prehensile organ ontogenetically as well as phylogenetically. Phylogenetically it was not till the air-breathing vertebrate stage that limbs were present and not till the hand-stage that the single hand was used to grasp an object, while only the higher apes oppose the thumb. The thumb is opposed to the other fingers in grasping sometimes as early as the twelfth week and Preyer found that the thumb and great toe were able to hold anything put in the hand and foot respectively at the end of the first week. It should be added that the child for some months will use feet as well as hands in feeling objects and the child born without arms learns to use his feet skillfully as hands. In the second quarter the child's head gets permanently balanced, he begins to sit alone, to move his body towards objects and to play with the things he is now able to grasp. The child is ambidextrous for the first half year at least and in most cases much longer. The apes appear to be all ambidextrous. The bilaterality of the movements of the child's limbs during the first few months is a repetition of the bilaterality of the lower vertebrates including the lower mammals. The child does not begin to use the hands independently of each other till the eighth or ninth month. Before this what one hand does the other also tends to do. In the second half year the lower limbs are constantly exercised while the child playfully learns to sit up without the aid of his hands, to roll, hitch and creep about, to stand and to stamp. In the third half year he at last learns to trot about on his feet (the instinct to do which is very early apparent) and he soon begins to extend this locomotive activity in many ways, turning, stepping over obstacles, stooping, jumping and climbing. Throwing—which no animal does instinctively and which only the ape can acquire, and that but imperfectly—is learned by the child in the second year, and much amusement is derived in the third year from watching where the things go and from throwing particular objects in particular ways, greater skill being continually desired and acquired.

Throughout this development of the child's muscles and senses through play, curiosity, as in the case of racial evolution, gains a continually increasing role. Notions of the external world are gained first of all through direct contact of objects with the lips, hands, and other parts of the body. But the eyes speedily assert their right to first place as the "windows of the soul." The child's first and almost immediate visual interest is for light and bright objects, then very soon for moving objects (which he begins to follow in the latter part of the month with the eyes and still earlier by moving the head) and then, from the second month on, with the aid of tactile and kinæsthetic sensations, for form, distance, and finally color; an order that is characteristic also of the phylogenetic development y/ of visual capacity and interest. It is pertinent in this connection to recall the exciting effect light has upon the most primitive vertebrate form still existing, the amphioxus, whose visual capacity only extends to the perception of light and shadow;

and the fascination which a bright light or fire possesses for fish and snakes and many higher animals; also the attention that moving objects invariably awaken in vertebrate animals. Again the progress of vision from monocular to binocular runs parallel in the animal and the child. There is a steady progress from the fish whose eyes are placed far back on the sides of the head and command independent fields of vision, to the ape whose eyes are placed well forward and share the same visual field. This is repeated in the lateral position of the eyes in the human embryo (which come gradually to the front as embryonic development goes on) and in their more or less independent and unsymmetrical functioning in early infancy, co-ordination not being perfected till the second month or later. It appears also that the infant's eye can be accommodated at first only for rather near vision (objects not much more or less than about fifteen or twenty inches off) and that the range of clear vision gradually increases both phylogenetically from the fishes on and ontogenetically from the second month on. The apes, which alone among the lower animals are capable of binocular vision, yet possess the power of convergence but imperfectly. We have some evidence of the existence among vertebrates of an interest in color, but the matter has received little attention. As soon as he can distinguish form, the child's attention is constantly being caught and held by some new object. From the time he begins to hear, also, the infant takes a keen delight in sounds, and early divines the direction from which they proceed, turning his eyes thither, according to some observers, in the first month and the head as well in the second month or soon after. These associations are very imperfect, however, before the third or even fourth month. Among animals we find the lower air-breathing vertebrates, and especially the lizards and snakes, much attracted by novel objects and sounds; while with the mammals the sense of hearing is exceedingly sharp and the head and ear, which in the mammals alone are movable, are turned promptly and instinctively in the direction of a sound. The child does not usually distinguish persons by their voices till the fourth month or later. This capacity the mammals, even some of the most primitive, hold in common with the child. Musical sounds early have a pleasurable and stimulating effect upon the child as upon reptiles and mammals, while the ape and year old child are alike fond of a drumming noise. Progress in discrimination proceeds so fast that by the fourth month the child already distinguishes faces and takes a peculiar and growing interest in them. The ape also is very observant of faces and capable of discriminating people by voice and looks, and forms judgments about persons as the child does from the face, voice and manner. In the second quarter the infant is fond of handling objects and is wide-awake to new sensations of touch, new sights and sounds, which he discriminates and recognizes and weaves together into a more and more intricate web of experience. He is no longer satisfied with seizing objects, but examines them and tries all manner of experiments with them, thus gaining a practical knowledge of the properties of matter. As he learns to creep and then to walk his opportunities of exercising muscle and sense enlarge, and his curiosity seems to grow more eager as the means of feeding it multiply. He carries on ceaseless investigations, and his chief delight is in objects that he can do something with; these he handles and makes to move in all sorts of ways.

So, phylogenetically, the mammal, aided by its improved senses and locomotive capacities, displays its more intense life in its playful activity and restless curiosity. The primitive mammals tumble about in the water, chase one another, and scuffle together, uttering their cries the while; and some of them display a prying disposition. But not till we reach the hand-animals do we find that habit of minute and systematic investigation so characteristic of the wonderfully observant and inquisitive ape. Likewise the sports of the ape bear a striking resemblance to those of the child. They consist of grasping, climbing, swinging, dancing, jumping, turning somersaults, screaming, drumming, scuffling, rolling, chasing, racing, riding, nursing and fussing with little animals (compare the child's passion for little animals and dolls), pretending to bite, teasing and playing tricks, destroying things, making experiments, overcoming difficulties, splashing about in the bath-tub, playing with fire and with bright objects and with other toys, making things move by striking or throwing.

The imitative instinct—so prominent in the ape also—is an additional impetus to the child's sportive activities particularly noticeable from the ninth month on; and the dramatic instinct begins to add its charm to the child's play in the second year. Animals and representations of animals are especially liked by the child in the second half year, and all kinds of moving objects together with the more striking aspects or phenomena of nature (the red sunset, thunder and lightning, the moon, the stars, bodies of water) arouse strong interest in the second half year and still more in the second year. Like the child the ape is also keenly interested in animals and it likes to look at bright colored pictures and representations of animals, which latter it often mistakes for real, showing that it resembles the child also in the precedence that sight takes of smell. There is, again, some evidence that such natural phenomena as storms, sunset, and sea arouse in the hand-animal an interest approaching the wonder of the child. There is a subtle connection between dread and liking, for no objects interest child and animal alike more than objects that are commonly objects of fear or that have already been such to the individual concerned. In the invention of expedients, in experimentation, and in the use of the method of trial and error in the latter part of the first year, the child shows considerable intelligence and judgment, being surpassed only by the most intelligent apes, namely the anthropoids, the guenon and possibly the capuchin, which he overtakes in the second year. It is significant that the child in the latter part of the first year, when placed in front of a mirror, reacts exactly like the ape, grasping at the image at first and later making a sudden grasp or taking a sudden look behind the mirror which he brings slowly towards him. The child in the first half of the second year finally recognizes himself in the glass and distinguishes himself from his own image, while the ape apparently never ceases to think that the reflection he sees is another living monkey.

In the second year, being able to move about more freely, the child begins eagerly to seek the origin and the cause of sounds—a characteristic also of the ape. In the second and third year the child is increasingly inquisitive with regard to the meaning and purpose of the things he sees. The ape shows by its actions a curiosity as active perhaps as that of a child in the middle of its second year, though the ape is not capable, like the child, of communicating in words its desire for knowledge, nor has it that capacity of understanding language which conditions the child's rapid advance in knowledge. The ape's capacity for understanding speech never takes him beyond the point reached by the child at the end of his first year, and being incapable of articulating he cannot learn even to name objects. The power to name objects adds greatly to the child's interest in them. He is quick to perceive resemblances and divides the world up into classes which grow ever narrower as new points of differentiation are observed. The child's crude reasoning in the second and third years is but another simple form of grouping by objective resemblance or contiguity, and is found quite as well developrd in the ape as in the two-year-old child.

Darwin and others assert that the ape sometimes emits a rudimentary kind of laugh when pleased. The child laughs in the second month and sometimes earlier, being particularly amused by rapid movements, while he exhibits roguishness and a sense of the grotesque early in the second year. This sense is apparently shared by the orang. The child distinguishes between greater and less in quantity or size in the first year, between one and many in the second year, and in the third has not only an idea of series but has distinct conceptions of several of the numbers, viz., one, two, and sometimes three, and may with pains be trained to still further knowledge of number. The ape is probably incapable of acquiring a conception of number. It is not till the third year that the child gives evidence of an understanding of the divisions of time, a knowledge that the ape can hardly attain to. Animals and little children alike have no thought of death, and the conception of death is one peculiarly difficult to convey to the child. By the middle of the second year, or at the latest by the beginning of the third year, the child has evidently come to clear consciousness of self as a unit distinct from the outside world which he has built up around him as his senses have developed. The interest in self is first plainly noticeable in the fourth month when the child spends much time in feeling himself and looking at his hands and feet. Then comes interest in the sounds that he makes and pride in the things that he does. With the acquisition of language this feeling of self naturally grows rapidly. The growth of the consciousness of self is also largely conditioned by the development of the child's feelings. The sensitive child is earlier self-conscious than the less impressionable. The fact that no animal, not even the sensitive ape, gives any evidence of shyness, inclines one to believe that the animals never attain to that degree of self-consciousness often reached by the child already in his second year.

Self Assertion.

In every expression of life there are probably two factors at work, the inner effort or reaction and the outer resistance or stimulus. What we call will is the predominance of the inner factor as compared with the influence of the outer. This inner force is seen to grow in strength, to become more prominent and more seemingly independent of outer forces, both phylogenetically as we ascend the animal scale and ontogenetically with the growing child. The reaction of protozoa and cœlenterates may be readily controlled by the use of various simple stimuli. The frog's reactions cannot be so readily predicted, while the ape's will is still much more developed in strength and complexity. Thus also does the child's wil grow from its almost passive and mechanical condition at birth to its vigorous initiative in the well-developed child of two years.

The invertebrates that we have considered as nearest the line of man's descent, when attacked, almost without exception, timidly seek to elude the enemy, and do not assume the offensive. With the development of a backbone, self assertion and anger become prominent qualities. Even the form of self assertion known as jealousy makes its appearance in the aquatic vertebrate stage, and the fishes energetically defend their property rights in food, home, mate and young. The expression of anger is much more diverse among the amphibia and reptiles than among the fishes. We find not only color-changes, sparkling of eyes, erection of appendages and inflation, as among the fish, but also sweating, foaming and the like, snapping of the jaws and, above all, rapid respiration with the utterance of various sounds. We have some interesting accounts of tyranny exerted by reptiles, especially lizards and snakes, over their fellows,. A new kind of jealousy is exhibited by the tame lizard which is jealous of attentions paid by its master to its companion lizards. But it is among the mammals that the self assertive instinct is most intense and it is among the apes in particular that its manifestations are most numerous and varied. Jealousy, teasing, tyranny, revenge, sensitiveness to ridicule, vanity, pettishness, contrariness, and impudence are characteristic of the apes, while the means of expressing anger have correspondingly multiplied, being as complex in the ape as in the year old child. In the hand-animals, too, the property instinct and the collecting instinct are strongly developed, for the apes are exceeding fond of stealing and accumulating and jealously defend their property.

The expression of angry impatience by the child is not for some time certainly distinguishable from a simple expression of pain or discomfort by crying, sputtering, wrinkling the face and shutting the eyes. But the loudness of the outcry a few days after birth, when his wants are not met, leaves little doubt in the mind. In the second month rigidity of the body accompanies violent crying. At three months the child will already ward off annoyance by the energetic use of his hands. As early as the fourth month the child has been observed to flush from anger, also to grunt, frown and twist about when uncomfortable. By the time he is one year old he will butt, scratch and bite the objects of his rage and also beat them, using first the open hand and later (*e. g.* sixteenth month) the fist. He will also make vigorous movements of the whole body when in a passion, throwing himself about and striking out with hands and feet. When able to walk, he will give vent to his displeasure by stamping (*e. g.* 20th month). Finally, in the third year, weapons are thrown in anger.

In proportion as the child develops strength he becomes more energetic and self-willed, hating to be crossed in his little endeavors and using his nascent capacities with more and more confidence and determination. He also takes an increasing delight and pride in his achievements from the fourth month on. The instinct to show off makes its appearance about the middle of the first year or a little later. In the second year anything forbidden possesses an especial fascination, anything recommended provokes distaste, and towards the end of the year compromises are suggested. Moreover, with the heightened self-consciousness so plainly exhibited about the end of the second year comes dignity, self-respect, and a sensitiveness to ridicule. In the third year selfhood is still more strongly manifested: the child begins to show independence of thought and action, and rebellion and wantonness are very common.

The self assertive instinct takes the form of jealousy as soon as the child is able to distinguish people. The teasing propensity appears rather early in the second year and soon becomes very strong; while in the latter part of the second year the child begins to take pleasure in exercising authority over other little children and over animals and dolls, which he sometimes uses badly.

Both in racial and in individual evolution the first property is food. When, in the fourth month, the child comes to recognize mother and nurse as the source of food and loving care, they also are jealously regarded in the light of property. Somewhat later, as the power to grasp objects becomes perfected, the child begins to regard the things he lays hold of as his own and to resent interference with them. Early in the second year he begins to show thieving propensities which he finds it hard to master. Not till about the middle of the second year, with the strengthening of his social instincts, does the child begin to have regard for the property rights of others. We have evidence of the appearance in the third year of the collecting instinct, which is an interesting outcrop of the instinct for property.

Social Instincts.

As in the protozoan so in the new-born child the social instinct appears as an outgrowth of the self-seeking instincts of hunger and self defence, and the history of life, both individual and racial, is a history of the growth at once of individuality and co-operation. We have some evidence of imitation and communication in the fish, and these instincts expand rapidly in the succeeding stages, especially in the mammalian, the social stages *par excellence*. In the primitive mammals the teaching instinct makes its appearance as an outgrowth of the now highly developed parental instinct, and with its appearance the activities become more intelligent and less purely instinctive. On the other hand the filial and imitative instincts become likewise very prominent as well as the instincts of communication, notably between parent and young, when danger threatens, by cries of warning and appeal. The voice becomes more prominent in the mammalian stages as a means of communication, though gestures, movements, and postures are also found, especially among the hand-animals. The capacity of forming friendships with other animals and with man, noticeable already in the early vertebrate stages, especially the early air-breathing stage, develops rapidly in the mammalian stages, and, like the other instincts, culminates in the hand-animals, which delight to use their arms and hands in nursing and fondling other little mammals, including children, and display great affection and sympathy for their friends.

The child is by nature very sociable from the beginning. He early displays the propensity to imitate (third quarter) and still earlier the finer capacity of suggestibility (fourth month or even much earlier) and in this he resembles the apes, which also are very imitative and very susceptible to facial and vocal expression. The simpler instinctive means of communication are most common during the first year, such as various cries of appeal which appear to become intentional already in the early weeks, the smile of sympathy and sounds of pleasure, which begin in the second month, various gestures as stretching out the arms and turning away the head, the latter in the fourth month, and interjectional sounds. By the end of the first year, the child's instinctive means of expression have developed so far as to equal those of the ape, except in the case of the social emotions, such as pity and grief, which are not so deep in the child as in the adult ape. Few new means of expression are added after this: the closing of the fist and the use of weapons in anger are instances, and these are not instinctively employed by the apes. The child's ability to understand human speech equals that of any animal by the end of the first year. In the fourth quarter the child may begin to use words and by the end of the fifth quarter—in some cases a little later—he has got by invention and imitation a small but useful vocabulary. By the end of the second year the child has generally gained a fair linguistic command of his little environment and possesses a great variety of means for expressing his wants and sentiments.

The child early smiles in answer to kindly looks and gentle sounds, and even in the second month smiling would seem to be sometimes an expression of fond interest. In the fourth month the expression of affection and sympathy, now no longer dubious, begins to be more active and complex, and in the second year—sometimes earlier—the child expresses his love by many overt acts, such as kissing, hugging and caressing and (in the latter part of the year) sharing his pleasures. The child like the ape is very sensitive to cross and mournful tones and looks, showing this sometimes as early as the fourth month; while pity would seem to be felt almost as early, and is readily excited in the year old child, as, indeed, it also is in the ape. In the latter part of the second year the child becomes, like the ape, not only very fond of, but also tender towards babies and little animals, with whose nature his own is so much akin. In weakness and capriciousness of will as well as educability in self-control by appeals to the instincts, the child in the second half-year is strikingly similar to the ape, but less and less so in the second year. With the somewhat complex relations of the higher animal societies and with the performance of brave and helpful deeds under the impulse of the social instincts, there would seem to develop in the higher mammals a feeling of what is fitting and what is unseemly, and this feeling is susceptible of considerable training through appeals to the animal's instincts. The child is so early subjected to training that it is hard to distinguish in his actions the instinctive and the acquired. His instinctive sympathy, however, which may be so early aroused for his friends, is already widely extended in the first part of the second year, when he feels with any sufferer, while shame may be felt as early as the ninth month. At the same time we find in him as in the ape many a conflict between the as yet very imperfect social instinct and the more selfish instincts of hunger and self assertion. The finer exhibitions of altruistic behavior in animals are irradiations of the sexual and parental instincts, and similarly in children it is not until adolescence that altruistic feelings and aspirations take on the glow of conviction and enthusiasm.

Blossoming Periods.

Three epochs in the growth of the child stand out prominently in the first year, namely the fifth week, the fourth month and the ninth month. These are turning points or rather blossoming periods in the child's history.

Before birth there are probably no senses awake but the tactile and kinæsthetic; the fœtus does not taste, smell, see or hear. It may have vague sensations of self and certainly in so constant and uniform a medium its sensations (tactile and thermal) of environment must be still vaguer. The sucking, swallowing, and clasping reflexes are present at birth. During the first month of post-natal life the child is occupied with feeding and sleeping and with a spontaneous and very indefinite play of the senses and muscles. He makes a certain number of adaptive movements, however, in connection with the hunger instinct, being guided by touch and temperature, by taste and smell and, though later and more imperfectly than in the case of these other senses, by sight. The instinct of self-defence is also at once apparent in the infant's reactions to mechanical and thermal stimuli (tickling, pressure, cold), to loss of equilibrium, to strong light and to loud or sudden sounds. The child takes pleasure in warm air and a warm bath, in the touch of soft warm objects, soothing sounds and mild light. Bright and moving objects arouse his curiosity and, if moved slowly in a horizontal direction, may be followed by the end of the month through movements of the head and eyes. The child expresses hunger, discomfort, and displeasure by screaming, frowning, shutting the eyes and moving the limbs energetically; comfort by smiling; and fear by trembling, shrinking and starting.

The fifth week is important, as the time when the child becomes able to perceive form. This new capacity nourishes the instinct of curiosity and from now on the visual sense of form occupies a large place in the child's associative activity. During the second and third months the child is vaguely sharpening his tools and forming certain simple but important associations. Interest in objects will now cause the child to cease crying and stimulates him to reach out and try to grasp them; he thus builds up notions of space. The range of sight and the interest in sounds alike steadily increase and the association between eye-movements and hearing is formed by the fourth month. Even before the fourth month the child plainly shows gun that he has began to store up memories. The expressions of pleasure in particular multiply in the second and third months, as we now find laughter and the utterance of various cooing and jubilant sounds; while in painful states tears are shed, and, later, sobs are uttered.

In the fourth month we find many phenomena appearing, often with striking suddenness and evidencing an awakening mind. There is the power of control shown by his successful efforts to grasp objects and to carry the hand to and from the mouth at will. There is the intelligent observation of his surroundings seen in the discrimination of faces, in the recognition of friends by their faces and voices, and now, or soon after, in the associations he forms between objects and sounds as words to indicate the objects. Animals begin to be feared, friends in a strange garb are taken for strangers and feared, and the child begins to learn caution from experience. Then begins also the interest in self, in feeling his body, in looking at his hands and feet, in listening to the sounds he makes and rejoicing in the things he succeeds in doing. Now also his smile is plainly intelligent and unmistakably expressive of fellow-feeling, and he is sensitive to scolding and other ways of expressing feeling with regard to him. At the same time he displays his self-assertive instinct in jealousy, in gestures of refusal and in the flush of anger.

During the fœtal existence and the first month after birth the child would appear to be recapitulating the invertebrate and cold-blooded vertebrate stages; and during the second and third months, the early mammalian stages. In the fourth month, anatomically (in nervous skeletal, and muscular development), and psychically, he enters the higher mammalian stage represented by the ape, in which stage he remains for some months. During these next few months the child makes rapid progress in building up definite objects out of his sense-impressions, his space-judgments rapidly increase and improve, he gains considerable control of the muscles of the upper limbs in handling objects, and succeeds in sitting up and moving about.

In the ninth month he is seen to have attained such control of his muscles that he is now able to use the hands separately for different purposes at the same time, and deliberately to do many things that he sees or hears others do. From the ninth month on his powers of attention and imitation grow so rapidly that by the end of the year he is more educable than any animal. It is significant that deliberate efforts to talk and to walk upright—characteristics of a stage more advanced than the ape represents—begin commonly in the fourth quarter and progress together. The child's further intellectual progress is conditioned largely by his power of speech, a means of progress that the ape lacks. The ape-like creature in man's direct line of descent must have also possessed at least potentially the capacity of articulation. The potential capacity for the habit of bipedal locomotion is sufficiently indicated not only in the apes but, to a less extent, in many other mammals and even in reptiles. In the fourth quarter, then, or at latest in the fifth, the child enters upon a heredity higher than is represented by any animal with which we are acquainted. Still, while in the use and understanding of speech, in the expression of most of the emotions, in self-consciousness, in suggestibility and educability the year old child is the equal of the ape, on the other hand, in many expressions of the self-assertive and social instincts, in play-activities (but not in imaginative play), in the memory of persons and events of interest, in curiosity and cunning, in judgment and reasoning, the most intelligent apes may be compared to a certain extent with the child throughout his second year. It is probably during the second year in the main that the child repeats the history of the stages intermediate between what I have called the imperfect hand stage and the stage of primitive man. The child's intelligent use of tools and weapons during this year would seem to bear this out, as well as his growing consciousness of self. In the third year the child shows capacities that are probably purely human, as, for example, his conception of number and time, his powers of imagination, his ability to think in language and to reproduce his mental images in drawings.

In the present state of our knowledge it has been possible to indicate only the larger features and a few scattered details of the parallelism between the psychical evolution of animals and the growth of the child-mind. A minuter statement must await fuller investigations. Each one of the topics brought forward well deserves special treatment in a monograph after careful observation and experiment with both animals and children. This much is, however, sufficiently evident, namely, that the evolution of instinct like the evolution of its concomitant, structure, follows the same lines of increasing differentiation and complexity and the conquest of an ever wider environment in the child as in the animal series.

CHAPTER III.

RECAPITULATION AND VARIATION PEDAGOGICALLY CONSIDERED.

We naturally inquire the explanation of the facts of which the recapitulation theory is a statement. It has been held true, as regards physical form, by scientists, such as Von Bär and Agassiz, who either did not know or did not believe in what we now call evolution, but who saw in it simply an expression of the will and design of the Great Spirit. Charles Darwin seems to have been the first to put forward a natural explanation, namely, in his law of variation and inheritance. "At whatever period of life a new character first appears," says Darwin, "it generally remains latent in the offspring until a corresponding age is attained, and then is developed. When this rule fails, the child generally exhibits the character at an earlier period than the parent." Hertwig and Wilson have since demonstrated that organs of great physiological importance, as, for example, the central nervous system, tend in general to appear earlier. "On this principle of inheritance at corresponding periods," continues Darwin, "we can understand how it is that most animals display from the germ to maturity such a marvellous succession of characters." Many scientists, *e. g.*, Fritz Müller, Häckel, Huxley and Balfour, have accepted this as the explanation with certain modifications. The fact that the principle is so freely departed from shows the explanation to be insufficient. The reason appears to be deeper than this, though Darwin did not see it. He speaks of "the embryo often retaining structures which are of no service to it, either at that or at a later period of life," and says, "There is no reason why, for instance, the wing of a bat, or the fin of a porpoise, should not have been sketched out with all their parts in proper proportions, as soon as any part became visible." The reason of this is explained by His and Kleinenberg, who seem to bring us nearer the truth, while giving us a principle that is very suggestive to the psychologist and the educationist. In "*Unsere Körperform*" (1874) Wilhelm His affirms that "each stage in development is both the physiological result of the foregoing and the necessary condition for the succeeding. To attain to complex, perfect, mature forms, the organism must pass through simple, imperfect embryonic forms." "This thought," he continues, "gives a new point of view from which to regard the fact that palingenetically old forms much resemble the embryonic forms of to-day. The former are embryonic because they have remained at a lower stage of development, the latter had to pass through the lower stages in order to reach the higher, not *because* their forefathers once passed through them, but simply from the inherent necessity of growth, which must always be from simple to complex; and the similarity between ancient simple and present embryonic forms would be comprehensible even if no relationship existed." Kleinenberg in his work on the *Lopodorynchus* offers much the same explanation for the existence of imperfect or rudimentary organs. He regards them as necessary to the origin of new and more perfect organs, both ontogenetically and phylogenetically. He cites, among many other examples, the notochord, which in the embryos of the higher vertebrates, is not retained, not even improved to form the vertebral column, but is rather *replaced* by the latter which grows around it and absorbs it in due time. Kleinenberg concludes that the notochord is necessary as a *stimulus* to the development of the vertebral column. "Of course," he says, "the skeleton develops in dependence upon the activity of the musculature; this latter, however, is in turn already brought into a definite form by the presence of the notochord. The notochord thus acts as a transition organ (*Vermittelungsorgan*) in the formation of the skeleton; even though the latter contains not a single element of the notochord, still it is only explicable through the previous existence of the notochord." W. K. Parker gives other beautiful illustrations of the same law in the growth of the oak around the heart-wood, and the thigh-bone in man about the small bone of the child, which becomes nothing but marrow. But if this is a law, how is it that the record is so often falsified; how is it that we have only sparse indications of the phylogeny in the ontogeny? The answer that naturally suggests itself is that from the principle of economy only those racial characters have been retained that are necessary for the proper development of later and higher characters.[1] If this is so, the importance of palingenetic characters, both physical and psychical, is the more manifest.

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[1] A. Sedgwick holds a view that is quite reconcilable with this opinion. In his opinion "ancestral stages of structure" (and doubtless he would also hold *of mind*) "are only retained in so far as they are useful to the free-growing organism, *i. e.*, to the larva" (and may we not

His's view, as he says, is not in opposition to the principle of descent itself, but it goes deeper; the fundamental cause he holds to be physiological and mechanical. And yet if one examine closely, one will find that though we have got farther we still have not the whole truth. "Differences in growth of different cells," says His, "cause new tensions according to which various folds and parts are formed." And so he formulates the law that "similar forms arise from similar material, when it offers similar conditions as regards absolute dimensions." But, we may ask, whence arise the *differences* in growth that in turn cause *new* tensions and the rest? There is no answer. E. B. Wilson,[1] indeed, confesses that "we are still profoundly ignorant of the nature and causes of differentiation and of its precise relation to cell-formation." As for Darwin's Law of Correlated Variation, Cope's Law of Acceleration and Retardation, Roux's Interselection, Minot's Post Selection and Weismann's fine-spun theories, while they certainly add light, they yet render our darkness as to the main point but the more visible. There seem to exist both an inner and an outer cause—the inner impetus being the tendency to vary, and the outer stimulus being the environment. But where the one begins and the other ends, it is impossible to say; they seem inextricably bound up together. In attempting to lean on either the one or the other, we are likely to beg the question continually; while by keeping both in view we find ourselves in a vicious circle, which has no beginning, and we are likely to conclude in despair that to know anything we must know all.

Whether the parallelism observed between the mental evolution of animals and the psychogenesis of the child be due to heredity or be but an illustration of a general law of growth—and it may be both—the fact of parallelism is patent enough, though often blurred either through insufficient observation or through the supervention of other principles and factors, as, for example, the differences that must obtain between adult and embryonic forms of life, and the necessity for condensation in the case of the embryo. The recapitulation theory may be only the statement of an analogy or a parallelism without any basis

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add *to the child?*) "in its free development. . . . . The only functionless ancestral structures which are preserved in development are those which at some time or another have been of use to the organism during its development after they have ceased to be so to the adult."—"On the Law of Development known as von Baer's Law and the significance of ancestral Rudiments in Embryonic Development." Quart. J. Mic. Sci. XXXVI (1894), pp. 35–52.

[1] The Mosaic Theory of Development: Biol. Lectures, Mar. Biol. Lab., 1894, p. 14.

in heredity properly speaking. It may be in the nature of living matter to go through immature stages which depend on the constitution of the matter and not necessarily on the course taken previously by similar matter. An explanation of the phenomena altogether apart from the recapitulatory one is often at hand and is probably always possible, but this does not lessen the significance of recapitulation but increases it. Indeed, if Weismann's theory is true, the living matter of to-day has never phylogenetically passed through any stages, but is a part of or directly derived from the original protoplasm which is continually unfolding in new directions and forms. Still as each new form most resembles the immediately preceding, the germ-plasm giving rise to it must also resemble it potentially more than it does previous forms. Hence, on this theory, the evolution of forms of life proceeds *pari passu* with and is dependent upon the evolution of form potentially in the germ-plasm, the environment having merely a selective influence. But even so, the facts of analogy are none the less interesting. As in the physical world, so in the psychical there is a natural order of growth. Since it is the order of nature that the new organism should pass through certain developmental stages, it behooves us to study nature's plan and seek rather to aid than to thwart it. For nature must be right; there is no higher criterion. There is therefore no study of more vital importance to the educationist than this of the natural development of organisms. The parallelism of phylogeny and ontogeny enforces the argument in favor of natural development and the doctrine of katharsis[1] or psychical vaccination as applied to the moral growth of the child. It furnishes a double support to the view that education should be a process of orderly and gradual unfolding, without precocity and without interference, from lower to ever higher stages; that forcing is unnatural and that the mental pabulum should be suited to the stage of development reached. So long as we keep the end in view and do not cause the child to linger in any of the stages we need not fear the discipline that each stage is calculated to give as a preparation for the next. For what Von Baer long ago said of animals is true also of the child: "The type of each animal appears to fix itself at the very beginning in the embryo and to dominate the whole development."

The period of animal recapitulation is short. In this work the attempt has not been made to deal with the recapitulation of human stages of development, but reasoning from the fact that the length of time taken to recapitulate a period does not depend upon the duration of that period phylogenetically but upon its recency, we may conclude that the recapitulation of human stages of development is much longer than that of the longest animal stage, viz., the ape-stage. If we ever succeed in establishing these human stages they should form a norm for the education of children, which in its earlier stages should be generalized and recapitulatory rather than specialized and individual. Recapitulation and variation are complementary, and, as the child develops, recapitulation becomes of less and less moment educationally and variation more and more important and *massgebend.* We know, for example, that the human mind developed in close union with the development of the body in hunting, in warring, in making weapons and tools, in tilling the ground, in domesticating animals, in cooking, building, etc., and the child's mind should be permitted to develop in a similar manner. All the great primitive crafts should be represented as far as possible in their most elementary features in the education of the child.[1] Only by passing through these old racial stages does the child get natural preparation and stimulus for the proper development of his own individuality. It is earnestly to be hoped, however, that even after these recapitulatory stages have been established, it will not be attempted to make a stereotyped curriculum of them. For children show all kinds of irregularities of development, which the teacher is bound to take account of. The bane of pedagogy has always been the tendency to systematize, from which even the greatest educators have not been free: witness Comenius, Pestalozzi, Frœbel and Herbart. While phylogeny has great suggestive value, ontogeny will always be more important for pedagogy. Nature will generally sufficiently indicate in the ontogeny that which is important to recapitulate; at the same time the study of phylogeny should endue us with insight and wisdom to take the hints that ontogeny gives. And when the period of specialization *par excellence* has arrived, the child's specialization should not be controlled for him by a cast iron system of class education; it should follow naturally the child's bent wherever this can be clearly discovered. And even if the bent should be in a different direction later on, let us follow—with caution, to be sure—still let us follow rather than lead there also, for the child's development is not necessarily, nor indeed generally, in a straight line.[1]

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[1] For the Aristotelian theory of Katharsis see Benn's "Greek Philosophers," Vol. I, p. 305. Compare G. S. Hall's application of this to development, *Am. Jour. Psych.*, Vol. IX, pp. 16 and 17.

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[1] For an appreciation of the educational value of gardening and the description of an ideal school-garden see "Die Erziehende Bede~~n~~tung u des Schulgartens," by O. W. Beyer; Langensalza, 1895, H. Beyer & Söhne. For an account of the aims, principles and methods of sloyd carpentry consult "The Theory of Educational Sloyd" and "The Teacher's Handbook of Sloyd," by Otto Salomon, 2nd ed., 1896. Silver, Burdett & Co., Boston. John Johnson shows in an exceedingly interesting way the development of a primitive sort of land tenure, legislation, judicial procedure and industry among the boys of a large school in Maryland, situated on a farm of 800 acres. "Rudimentary society among boys," Johns Hopkins Univ. Studies in Hist. and Pol. Sci., 2nd series, No. 11, Baltimore, 1884, pp. 9–56. Reprint, McDonogh, Md., 1893.

It comes out with great clearness from this study that while there is no such thing as an innate idea, still the mind of the child is not to be compared to a *tabula rasa*. The mind of the child is not merely nor chiefly receptive, but creative,—not passive wax to be moulded, but a living, active will, a bundle of instinctive tendencies to growth, within which his destiny is enwrapped. This is the fundamental part of man and conditions the more conscious part and will condition it as long as man exists. Instinct, not intelligence, still leads evolution. Intelligence is continually baffled and superseded, but instinct displays itself with the old vigor in ever new forms. It plays upon the intellect as upon a musical instrument and startles the old world every now and then with a new song.

It is the first business of the educator to discern these instinctive tendencies. And this he must do not only in the child as a type, but in each individual child with whom he deals; for there is no scientific principle better established than that of variation and none of more far-reaching importance. Biology teaches us that it is the over-specialized species that have always succumbed in the struggle. Man owes his pre-eminence to the fact that he is born an immature and generalized form and long retains this condition of plasticity. For this gives opportunity for the development of new and progressive variations and adaptations which keep him ever in the van of progress. Thus the crude early period of life, which Descartes so much deplored as a useless, nay, a positively noxious period, is, on the contrary, the very salvation of our race. Far from pessimistically seeking to tear down and rebuild the natural structure of those early years we should put faith in the promise of childhood and build reverently and hopefully upon the foundation it offers to our hand. If we should reverence the old man as representing the wisdom of the past, still more should we reverence the child, for he comes bearing the more glorious future. The Weismannian theory is at all events right in the emphasis it places upon the all-powerfulness of mother-nature and the futility and folly of struggling against her. It were better to study her plans and enlist in her service. Amid the dense mist of the Weismannian controversy, therefore, the teacher's course at least is clear. Wise education and improved environment consequent thereon favor the development, if not the appearance, of the best variations, which, once having appeared and developed, are the more likely to be handed down. Consider for a moment the case of the dog. If the variation of pointing, latent in the dog, if you will, had never been observed, seized upon and developed by education, we should have no pointers to-day. The latent or potential variation would have remained latent and selection could have taken no account of it. Education, then, may control variation and through variation selection and mould the child and the race to their best possibilities. The teacher's aim therefore—an aim which demands the highest order of ability—is to seek out the child's own best possibilities and educate these to the highest degree. And he can best find and feed these by offering to the child a varied diet suited to his stage of development, not attempting a systematic and specialized regimen in the first few years; for the child is his own best teacher. In other words, the educator must feed the child's germinal tendencies as they appear with the rich sensuous and motor experience that they call for, trusting to the child to respond to the healthy stimulus. If we cage a bird in the act of migrating, it is in vain that we offer him crumbs and berries, he leaves them untouched and beats his wings against the bars of the cage till he be given the free air and sky.

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[1] *Cf.* E. G. Lancaster: "The Psychology of Adolescence." *Ped. Sem.*, Vol. 5, 1897, p. 120: "The growth of the mind may be compared to a circle which enlarges by extending one sector at a time out to a new circumference."

The instinct of imitation, if we may call it an instinct, is not simple but presupposes the working of other instincts. The actions we imitate are those for which we have a natural bent, the acts of others serving only as stimuli, which may suggest like acts in us but do not necessarily unless we are by nature inclined to such acts. It is for this reason that the child is so suggestible, namely because his unformed mind is in an extremely generalized and plastic condition with a strong bent for experimentation in all directions. Here lies at once the strength and the weakness of childhood. And here lies the reason why early education should be broad and liberal, seeking to feed *all* the child's budding possibilities and not to determine his growth for him. Thus the child's predominant instinctive tendencies will have opportunity to develop in a natural and timely way into effective habits.

It becomes the teacher's duty, then, to examine the various kinds and modes of nutrition administered in the past and to keep his mind open for new and better ones. The old standard foods we are pretty well acquainted with. In the main the over-systematized plays and occupations of Frœbel, often unhygienic and unpsychological,[1] reading, writing and arithmetic, the catechism, grammar, formal essay writing and mechanical drawing, morbid gymnastics and a certain kind of history, literature and geography administered in very meager and systematic doses. The new foods, myth and story and proverb, free play, marching[2] and dancing[3] to good music, singing within the compass of the child's voice, and drawing, based on the child's own interest and fancy,[4] and nature study; leading in naturally manual training (with a view to making a *boy*, not a tool), and the three R's or rather including religion the four R's, together with linguistic reproduction, wide reading, art and science in proportion as the boy develops interest and capacity. Such a diet, administered with pedagogical insight and tact, could not but produce sound, sweet, vigorous youth, ready for the great examination of Life which searches all men. Synthesis—the building up of large synthetic views—comes late and should be allowed to come of itself, the teacher only taking care that plenty of good elements be given.

At the very beginning a study of the development of curiosity clearly suggests the importance of making the young child a companion of the bright flowers, the gay and musical trees and birds, the lively and playful animals, and of taking him to see men in action, as, for example, the various tradesmen at their work as well as the work going on about the house. He should be taken to fairs and festivals, shows and circuses, races and sports of all kinds and museums of art and nature. In this way the child's mind will be opened and enriched and his ambition stimulated. It is unfortunate that puppet-shows are so rare, when we consider the child's great natural love and creative genius for the drama.

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[1] In his study of motor ability (*Ped. Sem.*, 1894, III, 9–29) J. A. Hancock criticises as unnatural certain kindergarten methods that call for very fine and accurate muscular adjustments. F. Burk, indeed ("From fundamental to accessory in the development of the nervous system and of movements," *Ped. Sem.*, 1898, VI, pp. 62 and 63), is of the opinion that accuracy is not to be aimed at till the ninth or tenth year, because it requires a control that is not natural before then. For other criticisms not altogether so sound of Frœbelian methods, see N. Oppenheim's "Development of the Child," 1898, Chap. V. This writer puts too much emphasis upon knowledge, and entirely overlooks the unconscious or the sub-conscious, whose realm is wide and important, particularly in child-life.

[2] There are several little books containing pretty, graceful drills and marches for children with fans, brooms, flowers, dolls, flags, shepherd's crooks and the like. But these express only one side, and that the shallower side of child nature. What we need is a great artist who shall compose choral marches and religious drama for children or in which children shall bear a part.

[3] Of course, only quadrilles and simple dances under healthful conditions are meant.

[4] For an original use of drawing as a pedagogical device see C. A. Scott's article in the Transactions of the Illinois Society for Child Study, 1898, (Vol. III, No. 1,) entitled "Children's fears as material for expression and a basis for education in art."

While the child is in the stage of keen interest in the names of things, advantage should be taken of this interest in language to give him the names not only of common objects but of the various animals and plants in which he is interested, that he may associate the appearance, sounds, habits, etc., of each as a unit with its proper name. The importance of language in adding definiteness and durableness to impressions and ideas and in widening the sphere of observation and interest can hardly be overestimated. The interest, however, must come before the name and it should not be attempted to stimulate analysis and abstraction by talking to the little child about 'elipses' and 'petals' and 'molecules,' and training him to experience and name sensations and qualities which he has no interest in as such.[1] To do this is to give him information which cannot be of any use to him and which can have only the driest kind of pedantic interest. But to teach him the names of birds and insects, of flowers and trees, standing for what they represent as wholes, is to stimulate his interest in the beauties of nature and make his life richer and happier.

I have met a university graduate who did not know a carrot from a parsnip, and yet he hailed from a great agricultural State and was at the time an instructor in botany in a far-famed university. Many city children have never seen common farm animals, such as the cow and pig, their ideas of them being derived solely from pictures; so that some even think the cow a tiny animal about the size of a mouse.[2] Such children are being starved not only in one of their strongest interests, but also in language and ideas, for all languages are replete with metaphors, proverbs and other folk-lore which allude to animals and plants and which must therefore remain meaningless to them.

The neglect of common and yet beautiful and stimulating things by educators is further evidenced by the prevalence of color-blindness, not in the technical but in the æsthetic sense of the term. While having a crude sense of color, we are still apt in most cases to see only relative light and shade, and these but superficially. The changing hues of the water and of the distant woods, the red sun after rain falling upon the wet road-way, the varied tints of grasses, soil and snow, sky and cloud, all escape us. It is beautiful things above all that the child should be given to see and hear, for he has while quite young an instinct for the beautiful. Childhood is the time to attune the soul to beauty of form and color, to melody and harmony. The child is, moreover, an out-of-doors animal; he belongs to nature, and one can do him no greater service than by developing his love and appreciation of the beautiful in color, in bird-song, in cloud-form and in the scent of woods and fields. It were wise to develop in childhood and boyhood the love of the beautiful as a preparation for the appreciation in maturer years of poetry and art, as well as for the sake of its immediate ethical value in the culture of the feelings.

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[1] R. P. Halleck in his "Education of the Central Nervous System," 1897, lays much stress upon sensory training. But the course of sensory training recommended seems too specialized and conscious, not to say pedantic, for normal children.

[2] *Cf.* G. S. Hall: "The Contents of Children's Minds," reprinted from Princeton Review, 1883, by Kellog & Co., N. Y.

The intimate connection that we have seen to exist between curiosity and the play instinct, of itself suggests the importance of stimulating the development of the child's mind through the motor as well as the sensory channels. Children, and, indeed, adults also, learn best by doing, because they cannot do without attending. Any one who has studied one science by listening to lectures and reading books and another science or the same science later by working in the laboratory and the field, will have fully experienced the truth of this statement. This truth has not received sufficient application in our systems of sedentary education, particularly in the primary grades, where the application is most urgent. Every part of the living body is also in effect part of the soul, and the atrophy of any part of the body involves the partial paralysis of the soul. While true of every single tissue, this is most strikingly illustrated by the eye, the ear, the voice and the hand, the four great organs and avenues of the soul. It is strange that the hand, which has been of so vast importance in racial evolution, should be so much neglected in our educational systems. The little child in his self-activity teaches us better. If instead of the word "soul," as used above, the word *brain* is put, the statement will be more scientifically accurate, but practically amount to the same thing. The cerebrum, according to Flechsig, is divided into sensory areas and association areas. The sensory areas are at the same time motor areas, and this is especially true of the great somæsthetic sphere. The association areas, although penetrated by a few projection fibers, are in the main each a great net-work of paths between the various sensory-motor spheres. Moreover, the somæsthetic region is far richer in association systems than the other sensory regions, and indeed is intimately connected with all parts of the cortex. These facts clearly indicate the importance of uniting sensory and motor in education if we would wake up all the nerve-cells, make a well-developed, well-knit brain, a strong personality.

It is now admitted that the attempt to educate by direct appeals to imagination and verbal memory without the mind being previously enriched with images drawn from experience, is absurd. It is also beginning to be seen that education built up on a sensory experience that excludes the kinæsthetic element, no matter how otherwise rich and varied the sense-images, is and must be lop-sided. Indeed motor training is in a way more comprehensive than sensory, for while sensory training in most cases involves but little motor training, to wit: of the nervous centers for the sense-muscles (of great significance to be sure), motor training involves very great and varied use of the senses. "In most composite movements," to quote Du Bois-Reymond,[1] "something else than the control of the muscles by the motor-nervous system comes into consideration. The sight, the sense of pressure, and the muscular sense, and finally the mind, must be prepared to take in the position of the body at each instant, so that the muscles may be in a proper state of adjustment." The unity of sensory and motor is best seen in the hand, in which they are equally important and blend in a beautiful way that makes this the greatest organ of the soul and its training of the very highest value. Furthermore, motor training is of the highest significance for the training of the will, for the education of the will practically consists in the development of the co-ordination of muscle and mind. Flabby muscles of sense and movement, lazy observation, slovenly thought, atrophied emotion, all belong together, and are inconsistent with strong will-power. Thus all training, whether ostensibly directed to the body or to the mind affects the will, and that form of training which co-ordinates skillful and varied use of the muscles with observation and thought must afford the most effective education of the will.

The teacher should not single out any of the child's senses or muscles or groups of muscles for special direct training, not even the hand, voice, eye or ear. He should never forget that he is training a child, not a collection of senses and muscles. A method of training the will such as Seguin's,[2] which is successful with idiots, is not therefore necessarily to be recommended for normal children with muscles in good tone and minds wide awake and full of interests. In training the idiot, the object is to arouse interest; in educating the normal child, the object is to feed a spontaneity already abundantly present. In the case of the indifferent idiot, the training must be much more formal and systematic and the sole aim and result is to bring him to a condition weakly resembling that which the normal child naturally and speedily reaches by himself.

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[1] "The Physiology of Exercise." Pop. Sci. Mo., 1882, Vol. XXI, pp. 326 and 327.

[2] E. Seguin: "The psycho-physiological training of an idiotic hand," and of "an idiotic eye." Archives of Medicine, N. Y., 1879. Vol. II, pp. 149-156 and 1880, IV, pp. 217-233.

The training of the first few years—if one may judge from observation of the child—should in the main be of a large and general character, calling into play the harmonious and pleasurable action of as many muscles and senses as possible. There is nothing so healthful as pleasure, as cheerful interest. The little child of kindergarten age and under should be given tools, such as hammer, spade and wheelbarrow, suited to his strength, and plenty of large things made of various materials which he can handle and move about, for he takes a delight in putting forth his strength and overcoming difficulties, in getting practical acquaintance with the properties of matter and developing his kinæsthetic senses. It is not meant that this is his conscious aim, but the attainment of such knowledge is the practical result and the real source of his interest. E. Seguin[1] emphasizes the importance of meeting even the suckling's wishes in this regard: "To see and not to be able to reach, to perceive images with no possibility of seizing the objects, renders the infant impatient, fretful or unconcerned, and opens an era of exaction upon others, or of diffidence of himself, or of indifference for any attainment, which unavoidably ends in immorality or incapacity, or in both." The child should be given materials with which he can build (sand, large blocks, bricks, etc.), for he is a born architect, and divers simple mechanical contrivances upon which he may exercise his genius for investigation and experimentation.[2] He should also be put in the way of making objects that may serve as toys or as useful articles for the home, for the child delights to serve. In this way both self-assertive and social instincts would be appealed to and developed.

By the games that they have themselves created, chiefly through inheritance and imitation and partly through invention, children plainly tell us what their education should be,—to be left alone as much as possible with their games of strength and skill, of experimentation and imagination.[3] This is nature's way of educating the child, of making him intelligent and fitting him for the complex environment of manhood. By standing over the child and dictating its education, by imposing upon it his own habits of thought and action, the teacher thwarts the work of nature and makes a machine, not an intelligent, adaptable and virtuous man. If nature had intended to make a perfect piece of mechanism, she could have accomplished it by making a creature of full-formed habits and reflexes. But this nature does only in the case of the very lowest animals. As the animal scale is ascended we find more and more that the young must learn for themselves, and this they do in their play.[1] Among the higher animals, however, the parent often helps its young to learn, and the instinct in man to teach the young is a deep and true instinct.[2] But the human teacher, if he but try to interpret the purposes of nature, will see that it is not the lesson, the piece of work, the rule, the principle, the idea, that is of the first importance, but the intelligent mind which does the work and which wins the idea. He will also see that any system of training, whether mental or physical, whether grammar or gymnastics, which has from the child's standpoint no aim or interest but "the development of the mind" or "the perfecting of the body," is morbid and unnatural in principle and liable to do more harm than good in practice. Such aims are for the teacher, not for the pupil. For the pupil the work must be in itself calculated to arouse his interest and stimulate his best efforts, apart altogether from its supposed effect upon his mind or body. "Mental discipline" has but too often been the cry of defence of bad teachers and bad pedagogy. The introduction here and there in our schools of the school-garden and sloyd carpentry to supplement free play is an encouraging sign and must have the happiest results if only the true aim be kept in view. The principles that should govern motor training have been concisely stated by Gustaf Larson in a definition of sloyd: "Sloyd is tool-work so arranged and employed as to stimulate and promote vigorous intelligent self-activity for a purpose which the worker recognizes as good." With the rapid increase of urban population and the failure to set apart fields and groves in sufficient number and extent,

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[1] Pop. Sci. Mo., 1876, X p. 40.

[2] E. H. Lindley treats the puzzle interest in an original and interesting way in *Am. Jour. Psych.*, 1897, VIII, 431-493.

[3] See Alice B. Gomme's charming little book "Children's Singing Games with the tunes to which they are sung" (Macmillan's, 1894), and "The traditional games of England, Scotland and Ireland," by the same author; also W. W. Newell's "Games and Songs of American Children" (Harper Bros., 1884). For a beautiful instance of self-education through play, see "The Story of a Sand-Pile," by G. S. Hall, reprinted by Kellogg & Co., from Scribner's Magazine for June, 1888. The advantages of free play are well set forth in an article by J. L. Hughes, "The Educational value of Play and the recent play move-

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ment in Germany," Ed. Rev., N. Y., 1894, VIII, 327-336. Du Bois-Reymond ("The Physiology of Exercise," Pop. Sci. Mo., 1882, XXI, pp. 441, *et. seq.*), considers German turning superior educationally to English sport, particularly because "it results in a more equable perfecting of the body." It would seem that the German system should conduce rather to strength than to a healthy, natural development, and had best be used chiefly as a medicine to supplement sport.

[1] *Cf.* Gross: "Die Spiele der Thiere." 1896.

[2] *Cf.* D. E. Phillips: "The Teaching Instinct." *Ped. Sem.*, VI, 1899, pp. 188-245.

the conditions for healthful early training are continually becoming more difficult. Hence the growing necessity of artificially creating healthful conditions of early development by establishing playgrounds and erecting pavilions for the children of cities. S. V. Tsanoff has profoundly felt this need and outlines his plan for meeting the abnormal urban conditions in his book "The Educational value of Children's Playgrounds. A novel plan of character building."[1] The novelty of Tsanoff's idea consists not in recognizing play as a means of character-building, but in organizing and exploiting play consciously for that purpose, much as Frœbel organized it mainly for intellectual purposes. But surely here as in the kindergarten the best teachers will be those who need to interfere least; for children learn much better, much more naturally and practically from each other than from teachers. There is one function, however, that the teachers might perform to great advantage in these gatherings of the children, — namely, *story-telling*. This might be made of great educative influence and prepare the worse spirits to join in the sports with a good will.

The child's initiation into the delights of nature and history should begin at home in the natural history and culture history of his own neighborhood. By taking care that the child's associations with home are rich and full, we shall provide for the man an inexhaustible source of inspiration.[2] With this end in view the following is suggested as a sketch of an ideal curriculum for an American or Canadian school, depending for its success not upon text-books, examinations, and all the other impersonal paraphernalia of our systems of education, but solely upon the ability of the individual teacher. First, a study of the rocks and minerals of the neighborhood and the products thereof, as pebbles, sand, clay and soils. Second, a study of the topography and climate of the district. Third, a study of the plants and their relation to soils, together with work in garden and orchard, if possible; also a study of the woods and work with them *à la* sloyd. The wood-work should be co-ordinated with the Natural History in the making of shelves and cabinets for specimens, weather-vanes, bird-houses, and the like. Fourth, a study of the wild animals and the relation of the fauna with the flora, the climate and the topography of the district. The close connection of the industries of the neighborhood with the presence of these various natural conditions and products should then be noted: as mining, agriculture, lumbering, manufactures, commerce and navigation, and the accessory trades and professions. It should then be pointed out that such a collection of persons is a community with a thousand subtle interrelationships and interdependencies. A study of the government of such a municipality will then be in order, commencing with its present state and tracing it back to its beginnings, while showing the connection between this development and the growth of the community. Then the primitive savage community that preceded the coming of the white settler should be described and richly illustrated by Indian myth and story. Lastly, the perspective of geography and history should be widened outward and backward to include the county and district of which the community forms a part, then the province or state, then the country the continent, the empire, the world; the whole being continually illustrated by song and story drawn from the literature of the people in its various stages of development.

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[1] Philadelphia, 1897.

[2] *Cf.* Vachon: "Rembrandt als Erzieher," and Sir A. Geikie: "Types of Scenery and their Influence on Literature. London, 1898.

The study of the physiography, natural history and industries of the neighborhood should be observational. Two or three afternoons a week, at least, and occasionally a whole day should be spent in walks and excursions to the fields and woods, the mountains and waters; to mine and quarry, lime-kiln and brickyard, foundry and machine shop; to market and fair, farm and sugar-bush, mills and factories; to canal locks, harbor, lighthouse; to the shops of the shoemaker, carpenter, horseshoer, etc.; to large stores and warehouses; to law courts; to public buildings and works; to museums and fish-hatcheries, and to art galleries. The children should be taught how to find their way through the woods with and without a compass, and should be exercised in mimic bush-warfare and scouting and the sports of the season.

Individual collections should be made of the rocks, minerals, fossils, soils, woods and shells in the autumn term, and of pressed flowers, of moths and butterflies and other insects in the spring term. The school should also have a little museum, the best specimens being reserved for it. The flowers, leaves and birds should be drawn and painted and accounts given orally and in writing of the various excursions. Maps, topographical charts, clay models and sketches should be made, as well as records of the observations of nature, including the weather. Such a course should be begun in the kindergarten, the little ones being taught to collect flowers and leaves in spring and fall and to note their characteristic shapes and colors; to collect mosses, budding twigs, evergreen branches, nuts, berries, grain, seed, birds' nests, fruit and vegetables in the fall; and tastefully to decorate their room with these natural objects.

In this way observation and imagination, emotion and reason will develop hand in hand and not be separated as they are by our unnatural pigeon-hole methods of education. The child will be learning geography, geology, botany, zoölogy, history, literature, composition, drawing, painting, singing, manual work, in fact about everything, except mathematics, that is found in a school curriculum and much besides, and yet, learning them in a natural and coherent way, he will not feel burdened with a multiplicity of subjects. All will seem one subject, and each part of the work will derive interest and stimulus from the others.

Childhood is the time for the cultivation of the tastes both physical and psychical. Our ordinary conception of child education is too low and narrow. Nothing is too good for the child. His mind is vastly larger than our curricula. The truly great teacher is he who can reach out in all directions for an abundance of the best culture-material and work it over for the child into a fit state for him to digest. This is the primary teacher's true specialty—not to know one subject thoroughly as a specialist in that subject, but to have a rich store of information and accomplishment drawn from all sides, from nature and art, from history and literature, and from a wide experience both motor and psychical, and to be able to present this in a form suitable to his pupil's stage of development. In a word, the primary teacher's aim should be to make the child's mind a generously endowed apperceptive organ. The metaphor used, however, has its limitations, and in using it one runs the risk of being misunderstood. The teacher will need to exercise much judgment in seeing to it that the child earns this food over again for himself, and does not gulp it down passively in the old gradgrind way.

Children are naturally naïve, credulous, lovers of nature, eager to please, eager to learn, eager to do things. Why then these plaints we so often hear from both teachers and pupils? "I detest teaching!" "I hate school!" This is partly due to the almost purely sedentary, bookish and machine-like education given in our schools, curbing the child's vigorously sprouting will, repressing his beautiful play-instinct, constraining his rapidly waxing strength, his growing muscles tingling and hungering for activity. The early prominence in the child's speech of verbs and words used with verbal force is an evidence of the child's keen interest in activity.[1] At 8 years of age children are much more interested in the action of objects than in any other attribute;[2] and from about 5 to 9 years of age they are especially fond of representing action in their spontaneous drawings.[1] The healthy child is by nature *actively* receptive and must rebel or sicken under a cramming system. In the generalized state of his consciousness the child naturally reaches out in all directions for new experiences of taste and sight and sound, movement and emotion. He loves to impersonate people and animals and to make believe that one thing is another. He will be everything and do everything. That is the form which the self-assertive instinct takes at this early age. How unnatural to chain such pulsating life to a desk and enshroud it in a narrow school-curriculum! We rob him of his childhood by our forcing methods of confinement, silence and routine. Both before the "school-age" and during the first few years of school-life, we do the child injustice by making him the slave of a few definite habits, at a time when he would be still testing himself in all directions. We ought not to impose habits upon him but leave him to choose those directions most clearly indicated to him by his instinctive tastes and interests. It is for this that nature gives man a long period of immaturity—for this and for the building up of a strong physique to meet the ever-increasing demands of an advancing civilization. As human life becomes more complex, the plastic years of childhood become more and more precious and the question of their education more critical, more decisive for the future both of the individual and of the race.

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[1] *Cf.* F. Tracy: "The language of childhood," *Am. Jour. Psych.*, 1893, VI, p. 126.

[2] *Cf.* E. R. Shaw: "A comparative study on children's interests," Child Study Mo., 1896, II, pp. 152-167.

The present admittedly unsatisfactory state of education is also partly due to the teacher's lack of enthusiasm. A new enthusiasm is needed in teachers, which can only be given by an earnest study of the child as it is, actually and potentially, instead of the child as we would have it. Wisely to present culture material to the child and the youth, we must know their wants, we must fathom their instinctive tendencies and their natural capacities. The teacher intrudes himself too much upon the child; his art is too apparent. The true pedagogic method is not dictation but questioning and suggestion, with a view to throwing the child upon his own resources and developing the feeling of responsibility, self reliance and true pride out of his instinct of self assertion. The child does things best when he is at his ease; we should respect his naïveté, his spontaneity, his unconscious instinctive way of learning. Less system and more insight!

Again, this deplorable state of education is very largely due to our system of mass-teaching, which distinctly discourages true education and in most lines of study makes it all but impossible. The real difficulty after all is the financial one—school-taxes! It must be admitted that bad as is the education the people are getting, it is quite as good as they pay for, and to have a better they must pay far more. This is recognized in all other lines of business, but persistently ignored in the business of education, which must at all costs be made cheap! The number of children generally assigned to a teacher in our public schools is so great as to render individual study and training of the children exceedingly difficult. Nevertheless every true teacher will strive towards the attainment of this ideal. The child's all important instinct feelings of courage, pride, fear, anger, love and pity should be studied with a view to a full rounded development of them in worthy directions. And so the educator should begin by asking himself: In what instincts and instinct-feelings is this child strong? In what weak? What are his fears? Of what nature are the things that arouse his anger? and his sympathy? How great is his spontaneity? His power of self control? Which one or more of the four temperaments does he possess?[1] With what degree of impressionability or suggestibility is he endowed?[2] Is he predominantly emotional, intellectual or active?[2] Has he already contracted any bad habits?[3] Is he characteristically ambitious or lazy, confident or irresolute, careful or reckless, bold or timorous, yielding or contrary, frank or sly, sociable or shy, tender or rough? Of what nature are the things the child remembers best? What is the present state or content of the child's mind, his knowledge of things, of language, of number, etc.? That is to say, of what nature are his apperceptive organs? Is the child quick or slow-witted, alert or apathetic, attentive or scatter-brained, imaginative or matter-of-fact, inventive or rutty? Is he predominantly eye-, ear-, or motor-minded?[1] Is there a basis or explanation for his mental or moral qualities discernible in the physical condition or environment of the child?[2] What is the condition of each of his senses as compared with the normal? Is he precocious, backward, unsymmetrical or otherwise exceptional in physical, mental and emotional development?[3] Of what nature is his fatigue curve?[4] Is he well nourished or anæmic, cheerful or miserable, patient or irritable, quiet or restless,[1] stolid or nervous, choreic and uneasy? Making all due allowance for the age and the kaleidoscopic nature of the child, the answers to such questions will disclose the foundation upon which the educationist must build. Such an examination—made of course without the child suspecting it—cannot be too thorough, for it is essential as well for the proper physical and intellectual as for the emotional education of the child. The teacher should be a physiologist, and should have constantly in view the health of his pupils, his function being to prevent rather than to cure disease, for no education worth the name can be gained at the expense of health.

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[1] *Cf.* L. M. Maitland: "What children draw to please themselves," Inland Educator, 1895, I, 77-81. Children should be encouraged to illustrate by original drawings the stories they read or hear.

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[1] *Cf.* Wundt: Physiologische Psychologie, pp. 421-423.

[2] Bain contrasts the spontaneous activity of those of an "active temperament" with the activity of "sensitive and emotional natures," an activity that results "more from some stimulus or object than from an innate exuberance of action." "The Senses and the Intellect," 3d ed., 1886, p. 70. Ribot (Psychologie des Sentiments, 1896), from another point of view makes a subtle distinction between the "affective" and the intellectual type of mind. "There is," says Ribot, "an affective type of mind which consists in the easy, complete and preponderant revival of affective impressions." The majority of people, however, he believes, have no free, *i. e.*, complete, emotional memory, in which the intellectual element is only a means of revival and rapidly effaced. Donaldson (Growth of the Brain, p. 342) seeks to express these distinctions in the following rather crude neurological terms: "It is readily seen that a high degree of responsiveness among the central cells gives us the intellectual type of reaction. When the efferent portion is well organized, we have the anatomical conditions of the man of affairs or action, while exaggeration of the afferent or sensory component leads to a merely passive existence or to hysteria, according to circumstances." It is more probable that the true basis for all types of mind is found in the peculiar disposition of the central cells—of which we know next to nothing.

[3] S. E. Wiltse makes a skillful use of suggestion in story telling to counteract bad habits. See "The Place of the story in early Education." Boston, 1892. Ginn & Co.

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[1] Consult on this matter F. Queyrat: "L' imagination et ses variétés chez l' enfant," Paris, 1893; W. H. Burnham: "Individual Differences in the Imagination of Children," *Ped. Sem.*, 1893, Vol. II, pp. 204-225; Donaldson; "The Growth of the Brain," pp. 341 and 342; and A. Fraser: "Visualization as a chief source of the psychology of Hobbes, Locke, Berkeley and Hume, *Am. Jour. Psy.*, 1891, IV, pp. 230-247.

[2] W. T. Porter ("Physical basis of precocity and dullness," Am. Phys. Ed. Rev. Vol. II, 1897, pp. 155-173) found that of children of the same age in the St. Louis schools, the dull were inferior, and the precocious superior to the average in weight, height, girth of chest and width of head, but the comparative growth of the three classes was the same. For much information along this line, useful to the teacher desirous of doing justice to his pupils, see F. Warner's works, and especially "The Study of Children and their School Training," 1897, Macmillan & Co., N.Y., and "A course of lectures on the growth and means of training of the mental faculty." Cambridge, at the Univ. Press, 1890. The latter contains lists of references to Dr. Warner's other contributions. F. Burk makes a résumé of the various studies of children's growth in height and weight in *Amer, Jour. Psych.* 1898, IX, pp. 253-326. The teacher should also have at his elbow, H. B. Dowkin's "Diseases of Childhood," London, 1893; Chas. Griffin & Co. For further references see the very complete "Bibliography of School Hygiene," by Wm. H. Burnham, Clark Univ., in Proc. Nat. Ed. Assoc. 1898. The question of psychological differences in children, due to sex, has received but little attention as yet. E. H. Bentley ("Sex differences that have been brought out by child study," North Western Monthly, Lincoln, Neb., 1897, Vol. VIII, pp. 257-261) has gathered together most of the meager information we have; but this matter does not attain prime importance till puberty.

[3] The educationist will find E. W. Bohannon's "Study of peculiar and exceptional children," suggestive in this connection: *Ped. Sem.* IV, 1896, pp. 3-60. For some excellent advice as to the study and treatment of neurotic children, see an article by J. Royce on "Mental defect and disorder from the teacher's point of view," Ed. Rev., N. Y., 1893, Vol. VI, especially pp. 451, *et seq.*

[4] *Cf.* E. Kräpelin: "zur Hygiene der arbeit," 1896: "Children are incomparably more fatiguable than adults, but there exist among them extraordinarily great differences, which are the more liable to be overlooked since great fatiguability is usually associated with great capacity for improving one's work by practice." In his treatise "uber Ueb geistige Arbeit," 1897, Kräpelin strongly condemns the present long

The young child is not reflective; he does not naturally make the conscious distinction between right and wrong, therefore he is not moral—nor is he immoral. But he does instinctively many things that are right as well as many things that are wrong from our standpoint; he is kind and sympathetic, but also greedy and cruel; therefore he is instinctively good, but also instinctively bad. In fact not only our terms 'moral' and 'immoral' but also 'selfish' and 'altruistic,' 'cruel' and 'sympathetic' and the like are terms whose meaning has shaped itself from the adult standpoint and largely from a consideration of adult conduct; they are terms of adult ethics and not applicable to childhood without great reservations. The child passes through a purely instinctive animal stage. His conscience is made up of instinctive feelings, not reflective knowledge. The great pedagogic problem of to-day is: How shall we bring the child safe and sound through this stage without, on the one hand, lopping off those basal animal instincts that often express themselves in ugly forms and getting as a product an atrophied creature lacking the fire and color of youth; and, on the other hand, without risking the growth and permanence of evil habits by an extreme and impracticable policy of *laisser faire?* Rousseau, entirely ignoring man's social instincts, fondly believed that in a "state of nature" freed from contact with man the child would grow up a perfectly symmetrical being. The accounts we have of feral children[2] are calculated to quench such false optimism.

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hours of school and infrequent recesses and believes that, under present conditions, inattention is the pupil's only safeguard and consequently "tedious teachers are a real necessity." The true remedy, however, lies rather in reforming education than in shortening the time devoted to it, always excepting the "home-work," which should be abolished at least from the primary and grammar schools.

[1] *Cf.* H. S. Curtis on "Inhibition," *Ped. Sem.*, 1898, VI, pp. 97-100.

[2] *Cf.* E. B. Taylor: "Wild Men and Beast Children." Anthrop. Rev., 1863, I, pp. 23-30; and A. Rauber: "Homo sapiens ferus oder die Zustände der Verwilderten in ihrer Bedeutung für Wissenschaft, Politik und Schule. Biologische Untersuchung." Zweite Auflage, Leipzig, 1888.

On the other hand the pessimistic belief in total depravity and the necessity of making the child over again from the beginning is equally unfounded; the great rebirth comes naturally at adolescence. Meanwhile the normal and healthy education of the child's sentiments from birth to puberty can only be ascertained by each educator for himself by reverent study of the child's nature with a view to securing to him the full pedagogic value of lower stages of growth and of bridging him over in a tactful and timely way to ever higher.[1] One thing comes out clearly from this study of the child's instincts, viz., that the child by nature is and must be predominantly self-seeking, demanding and receiving more than he gives, and hence any premature grafting of altruism upon him is liable to produce a sickly growth.[2]

Nevertheless, though not naturally altruistic or self-denying, the child is social, making friends readily with all creatures and even including in his catholic sympathies inanimate things, for imaginative childhood takes little account of the distinction between animate and inanimate. This, then, is a valuable clue and starting point for the educator—intercourse and friendship, not only in the home circle, but with other children, with animals, with the flowers and the moon and the clouds. The great phenomena of nature, whose beauty, majesty and mystery appeals so strongly to the child, are his first natural objects of worship. The child who is permitted and encouraged in awe and love of these as superior beings will have all the more perfect reverence for a purer God later on, as well as a keener scientific interest in the works of nature.[3]

The child's instincts are not due to environment, his habits are, in the main; the former are inherited, the latter are largely acquired as a result of education, using this word education in its broadest sense. And herein lies a great distinction between man and animals; for with animals habits are mainly innate and fixed, and this to an increasing extent as the animal scale is descended. But the great all-conditioning instincts and instinct-feelings are due, in animal and child alike, entirely to heredity and variation,—indeed one may say that psychically they *are* the animal and the child. Happy is the child who is richly endowed therewith. These instincts, then, which every child has, although in varying form and vigor, must be turned into worthy grooves. Not suppression but a generous control!

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[1] There is no more convenient means of applying at once the doctrines of catharsis and of recapitulation than in the selection of the child's reading.

[2] The natural time for emotional training and a training in ideals is the period of adolescence. *Cf.* W. H. Burnham: "The Study of Adolescence." *Ped. Sem.*, 1891, I, p. 194.

[3] *Cf.* G. S. Hall: "The moral and religious training of children and adolescents," *Ped. Sem.*, I. pp. 196-210; and Jean Panl Richter (Levana): "When what is mighty appears in nature, a storm, the starry firmament, death, then utter the word 'God' before the child."

Character is the habitual direction taken by the individual in response to his instincts. It is evident, therefore, that the formation of character is the end and aim of education. While enlightenment and reflection must and should come in good time if the youth shows taste and capacity for it, nevertheless the great aim to be kept ever in view is the forming of good habits of feeling and action rather than the habits of self-examination and ethical and philosophical reflection. To do right from instinct and habit, mechanically, if you like, and because one cannot do otherwise, is infinitely preferable to a reasoned morality. If it be borne in mind how suggestible the child is, how strong, how omnipresent his imitative instincts, the gravity of the teacher's function will be appreciated. The strenuous endeavor of the teacher should ever be to help his pupils to be *themselves*.

LITERATURE.

Shakespeare, Voltaire e Alfieri e la tragedia di Cesare. Saggio di critica psicologica. LUIGI DE ROSA. Parte Prima. Camerino, Tipografia Savini. 1900. pp. xiv + 389.

Professor de Rosa's book is the first part of an interesting study in comparative literature from a psychological point of view. Among the topics discussed are: the age and tendency of Alfieri and Voltaire; Shakespeare's times and his marked objectivity; the Teutonic mind and the dramas of Shakespeare; the psychology of Shakespeare and classical psychology; Shakespeare's dramas and the classical drama; Shakespeare and Voltaire; Shakespeare and Alfieri; Voltaire and Alfieri. According to the author, Alfieri, as the initiator of revolutionary literature in Italy, and Voltaire, as the protagonist of rationalism in France, were both "*tendence*-poets," but the liberal movement in Voltaire's mind was for free thought and did not directly oppose itself to despotism, while Alfieri's liberalism was coincident with tyrannophobia. Voltaire was a "gentleman of the king," who looked upon royalty as a cure for the "canaille." Alfieri, it is true, did not love the demos as much as he hated the tyrant, but he was a great deal nearer the democratic ideal of to-day than was the great Frenchman. In Voltaire, too, the critic and the poet were more out of harmony with each other than was the case with Alfieri, who was always more coherent and less incongruous, and was able to "execute what Voltaire only dreamed about." In their tendencies towards simplicity, their desire to make an effect, and their didactic penchant, these two men of letters resembled each other, but with not able individual differences. Neither by art nor by their genius do Voltaire and Alfieri "belong to the family of Shakespeare," but the latter is closer to him than the former. Shakespeare is no "*tendence*-poet," for he is, as Coleridge said, "hundred-sided, thousand-souled;" he is the "ocean-man." To use Professor de Rosa's words (p. 29): While Voltaire, and, even more markedly, Alfieri, always put a part of themselves into all the creations of their mind, Shakespeare is able to personify, one after the other, all the ideas and all the tendencies, to objectivize himself in all forms, and to make them all live, forgetting himself almost completely." In other words, Voltaire and Alfieri are manifest in all their creations; Shakespeare lies hidden behind his. The last has the fundamental characteristic of genius. Shakespeare is the ensoulment of the Teutonic mind with its concepts of art and of ethics; he represents the Teutonic as opposed to the classic mind, being preoccupied by the inward reality, the secret face of human facts as they present themselves before the conscience of man. What is within man belongs to Shakespeare more than to any other poet. Shakespeare's personages have an evolution such as none in the classical dramas ever have; they are individuals who live and move and have their being as men and women of flesh and blood, natural and not artificial. They have all the phases of human personality; they are governed and transformed continually in accordance with the supreme laws of environmental adaptation. The play of circumstances, the labor of the individual are both made genial by his art. The text of Shakespeare is nature's own manuscript. He is the priest of

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An Educational Experiment.

By Dr. Cephas Guillet.

Dr. Cephas Guillet.

THE present writer had the hardihood to found and conduct for five years a day school, which should be limited to twenty boys from eight to fourteen years of age, and which should devote only half the day to the usual school regime of text-books, reserving the afternoons, and occasionally a whole day, for manual work and the direct study of environment, both natural and cultural. In this undertaking he had a fourfold ideal in view, namely, to try to make the education of the boy healthful, practical, liberal and natural. Healthful, in neglecting the demands neither of the growing body nor of the growing mind ; but endeavoring to make a well-developed, well-knit brain, while not only not interfering with the growth of the body, but actively encouraging and stimulating its growth. Practical, not in fitting the boy for some special calling, but in leading him to apply his knowledge in a practical way to real things, to real work. Liberal, in addressing itself to the whole organism. And natural, in being based on a knowledge of the boy's nature and needs.

From eight to ten the child grows very fast in size and strength, and displays much wider activity of body and mind. In my own school I tested the boys' strength of grip with the hand dynamometer every month for about two years, and found that, between 8½ and 10½ years of age, the boys' strength of grip in the right hand increased 6½ kilograms, while from 10½ to 13 it increased only 2¼ kilograms. After 13 the increase was again very rapid, more rapid even than between 8½ and 10½ years. This would indicate that the years from 8 to 10 are a transition period between childhood and boyhood, while the early teens are a transition period from boyhood to manhood. As my boys ranged from eight to fourteen

GEOLOGY.

Studying Formation of Parliament Cliff.

years of age, I had them throughout the period of boyhood, with very little overlapping either to childhood at one end or to adolescence at the other. My problem was thus simplified. It was to properly educate, not the child, nor the young man, but the boy.

The characteristic mental quality of boyhood is curiosity. The boy is a born investigator. His curiosity is many-sided and he takes a keen interest in the facts of nature and history. This is the time, then, to bring the boy into close touch with nature, to lead him to learn her facts at first hand, and, in so doing, to gain true, clear, and beautiful perceptions. The curriculum cannot be too rich and liberal for the boy. All his budding interests should be appealed to, all his budding capacities developed, to the end that he may *find himself.*

NATURAL HISTORY.
Becoming Acquainted with Inhabitants of the Ottawa River.

The teacher should get down to the boy; get his point of view; enter into his feelings; educate him from within by growing with him, not from without by trying to push or pull him upward. The teacher should learn things over again with him, help him actively to discover, to invent, to produce, rather than passively to imbibe, for the boy is naturally an investigator, an experimenter, a doer and a maker. His knowledge should issue as well as begin in action.

With this end in view, then, I led the boys in several expeditions a week throughout the year to study their native environment of town and country; the buildings of man and of nature; rock and soil, river and forest, in their native state and also as exploited by man; in a word all the busy, varied life of nature and of man.

The nature of the investigation and work was conditional largely by the season. In the Fall we studied the crust of the earth, beginning at the soil and working downwards, examining the successive geological formations as we proceeded, and getting acquainted with the varied life that has its home in the surface soil and water.

One year we made a special study of shells of land and water; another year, of the fossils of the Flood or Pleistocene period; another year, of the fossils of the sedimentary rocks; another year, of the metamorphic rocks and minerals. In this connection we stud~~y~~ied together the topography of the locality and the changes large and small that have been~~,~~ and are being made in it by various forces of nature, and in particular by the erosive power of water.

The winter afternoons we devoted partly to manual work,—drawing, designing, simple carpentry, modelling in clay and in snow, and carving in oak and other hard-woods—and partly to the study of our human our historical and cultural environment ; the city and country, their history, their institutions and industries as conditioned by the physical resources and advantages at hand. From this as a centre we could broaden out in space and time as seemed most interesting and appropriate.

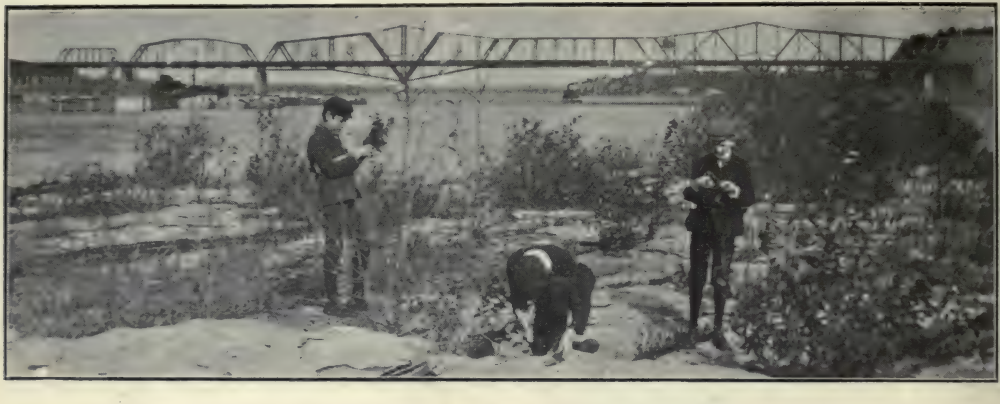
Scouting.

In the spring we studied the life springing up all about us—the life of earth and water and air, and in particular the plants and birds, sometimes attempting a somewhat exhaustive investigation of some small and homogeneous locality.

But we were not content with observing outdoors : we sought to do things, to form an acquaintance with the actual out of doors life of the pioneer and the farmer, with their primitive occupations so dear to the primitive heart of the boy. We played scouting games in the woods in the fall. We conducted in the fall and winter a valuation survey of a piece of woods, charting it and ascertaining the nature and value of the timber it contained. In the spring, we made maple syrup and sugar, going through the whole process intelligently from the tapping of a score of trees to sugaring off. We transplanted shrubs, herbs and ferns from the woods to our gardens in spring and to pots for winter. We set up vivaria and aquaria.

Transplanting

The boys were weighed and measured regularly. From these records I have plotted curves showing the increase in height and weight of each boy during his attendance at school. Comparing these curves with the average curves of increase of English boys as ascertained by Roberts, I was gratified to find that on an average my boys gained, during an average attendance of a little over two years, each over two pounds in weight and over seven-tenths of an inch in height *relatively to the normal.* That is to say, if a boy on entering was below the normal, he was not so far below the normal, if at all, in leaving ; and if he entered above the normal, he left further above the normal. As a boy, if h does not get his normal growth at the proper period of growth, he will likely never ge it, but will be to that extent forever stunted, the significance of these facts and thei application to our present day bookish education can easily be imagined. Th reader must judge whether the education here sketched is what it set out to be— healthful, practical, liberal and natural; and whether the education commonl given in our schools is characterized by all or any of these ideals.



BOTANY.
The Flora of Pine Island.

A GLIMPSE AT A NATURE SCHOOL.

(Ped. Sem. Mar. 1904

By **Cephas Guillet, Ph. D.**, Sometime Fellow at Clark University.

In the little Canadian capital, September, 1899, the present writer opened a school in which he might have a free hand in carrying out in practice certain educational ideals which he had formed. It is not the purpose of this article to discuss these ideals[1], but simply to give a brief illustrated account of a part of the work of the school; in which account the principles will sufficiently appear without extended comment.

At this school, then, in the afternoons, books are laid aside, and the boys, whose number is limited to twenty, are so led to a study of their environment, that their best energies both physical and mental may be called forth, and their interest in the wonders and beauties of nature may be made ever keener, more intelligent and more reverent.

The character of the work done varies with the season. In this article a description of fall work only is attempted. Attention is focussed in the autumn upon Mother Earth—the soil, its formation and inhabitants; the sub-soils, their nature and origin; and the rocky crust of the earth.

Outings take up two or three afternoons a week, and sometimes a whole day for more distant expeditions. The other afternoons are spent in two ways: first, in labelling and classifying specimens, in discussing the facts gathered during the outings (in which discussions questions are frequently left to be thought over and decided in future outings), and in making and memorizing topographical and geological maps and charts (of Ottawa, of the district, of the great valley of the St. Lawrence system, of our continent at various geological periods); second, in drawing and coloring leaves, shells, various animals met with in the rambles, etc., both from life and from memory, so as to fix the various forms in the mind. Some of these forms are afterwards conventionalized and used in designs; ideas of artistic beauty having first been developed by a training in drawing, with pencil, crayon and brush, the classical units, and arranging them in patterns after the admirable manner outlined in Mr. Tadd's beautiful work, "New Methods in Education."

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[1] For a discussion of these ideals see an article entitled "Recapitulation and Education," *Ped. Sem.*, October, 1900, Vol. VII.

Beginning at the surface of the earth, collections are made of various kinds of soil; of the various leaves of tree and shrub which help to enrich it; of many of the animals that make their home in or upon the soil. Some of these last, such as the toad, salamander and snake, are kept in a vivarium under as natural conditions as possible. Collections are made of the shells of the locality, some of the water-mollusks being kept in an aquarium that their habits may be observed. Both vivarium and aquarium are a perennial source of interest to the boys, most of whom have needed no further suggestion to start similar ones at home. In the fall of 1902 the school collected in its outings some sixty species of snails and bivalves and the boys vied with one another in getting the largest number possible. The two most expert found forty each. The boys have taken great pride in their collections, readily spending their pocket-money to purchase suitable boxes to contain them. One pupil who had lived two years on the Pacific coast said to me one day: "I wish I had known what I know now when I was at S——: I could have got a splendid collection of shells there." That boy's eyes were being opened. Of another boy his parent told me: "He often stands long before our case of sea-shells now; he never used to look at them." In their search for the shells the boys naturally learn much regarding the habits of the "shell-fish."

Then the sub-soils — the shell marl, clays and sands — are studied with a view to understanding their nature and origin. The work done by running water is investigated in this connection. The noble Ottawa, one of the oldest rivers in the world, is a striking illustration of the wonderful erosive power of streams; for, in making its channels it has worn down a deep broad valley from the Chelsea hills on the north to the great limestone cliff, now crowned with the Canadian parliament buildings, which stubbornly disputes its progress to the south. But the study of the Ottawa itself is led up to by a study of the work of streams large and small which flow into it. Boys naturally love the water and it is easy to turn this feeling into intelligent channels.

In the discussion of the geological facts, the pupils are led to make inferences regarding the history of the earth as recorded in the phenomena observed. There is near a little lake east of Ottawa a sandy cliff twenty feet high topped with a band of marl about two feet thick with the soil immediately above. This band descends in an incline to the present level of the lake. In the marl the boys have found about a dozen species of shells similar to those they have fished out of the lake with living mollusks in them, with the exception of one species which has possibly become extinct. From this the inference is made by the boys that the top of the cliff was once part of the bottom of the lake, and that the surface of the lake has gradually lowered to its present level. We explore the shores of the lake, paying particular attention to the two little streams that feed it. We follow them up to their sources and examine them with a view to finding the work they do in cutting their channels and in gradually filling the lake with sediment. Going, then, to the outlet of the lake, we find a stream flowing through a gully to the Ottawa River, with a high clay bank on each side. With a little consideration most of the pupils grasp the change that has taken place in the size of the lake and the cause thereof; and the questions they themselves ask me — for example, "Why don't you find marl on this side, too?" — show that they are learning both to observe and to think. When the stream draining the lake is swollen with rain or melting snow, its cutting power is particularly apparent. To assist the slower pupils, I fill three similar bottles with water — one from the lake, one from the stream soon after it issues from the lake, and the third from the stream where it empties into the river. The increasing quantity of sediment in the three bottles demonstrates the work of the stream. The stream has cut its way down through this great field of clay separating the lake from the Ottawa River. This explains the gradual lowering of the lake's surface to its present level. Judging from the present rate of erosion, the marl at the top of the cliff must have been deposited many hundred years ago. In time the lake will be drained so as to leave only the meandering channel of a little creek.

In a brickyard near the Rideau River, where digging is pretty constantly going forward in the blue "Leda" clay, out of which red bricks are made, the boys have found besides some fossil land-plants and a fossil beetle, many marine fossils: — foraminifera, bryozoa, sponge spicules, a piece of a sea-urchin, the tube of a worm, the shells of about a dozen snails and bivalves, opercular valves of barnacles, and a vertebra of a fair-sized fish; and others have found the bones of seals. The boys enter upon this work with real enthusiasm. A lucky find is a source of delight to the finder and of good-humored envy and increased zeal to the others. They frequently stake off claims, which are quite as much respected among the boys as they would be among their elders. One afternoon, while hunting for fossils, a new boy asked me, "Shall we have any school this afternoon?" One of the other boys replied for me: "Why! this is school." "Is this school?" exclaimed the first. "Why! I'd rather do this than play at home!" The boys perceive that the shells of the Leda clay are quite different from any recent shells they have found in the neighborhood and quite similar to shells which they have brought me from the seashore. A gift-collection is one of the features of the school, the boys bringing home from their vacation-travels many interesting natural history objects, some of which they present to the school. One of the boys brought to the school some shells which his father found in the mud dredged from the bottom of the sea, fifty-seven fathoms deep, off the coast of Newfoundland. One of these, *Macoma calcarea*, we also found in the Leda clay of Ottawa. A drive of a few miles to the east of Ottawa (visiting a sulphur spring on the way) brings us to a little tributary of the Ottawa called Green's Creek, celebrated in Pleistocene geology by the presence in abundance of clay-nodules washed by it out of the Leda clay. Carefully splitting open these nodules, the boys find beautifully preserved specimens of many organic forms, and especially of marine fishes, which are at present found living in the Gulf of St. Lawrence. Naturally all do not display equal interest. The extreme of interest is illustrated by a boy of ten years who took three leather bags and filled all with nodules; so that I felt obliged to carry one for him, another he slung over his shoulder, and the third he dragged sturdily along over the muddy shore. At the other extreme is the unhappy boy who must not get his boots or clothes soiled.

The boys readily reason that this clay in which marine fossils are found is of marine origin, the sediment from an arm of the sea which formerly extended up the St. Lawrence and Ottawa valley. They have been taken also to the Chelsea hills, a part of the Laurentide Mountains, a few miles north of the city, where they have found, in a deposit of "Saxicava" sand four hundred feet above the sea, several fossil shallow-water sea-shells: showing that here was once a beach of that ancient sea. And they are told that away across the St. Lawrence valley, high up in the Adirondacks, are similar remains, showing that the men of those ancient times, thousands of years ago, could have sailed over the sea from the Laurentides to the Adirondacks. This was the Pleistocene age or age of the Flood, and the gradual recession of the waters as the land rose again is marked at various levels by deposits similar to those found at Chelsea. The beautiful story of the Flood, found in our Bible, is recalled in this connection, as well as legends of other peoples, and particularly the Indians, legends which show the indelible impression made upon the human mind by that wonderful catastrophe.

They are also taken to see glacial striæ on the rocks and deposits of boulder clay, which sometimes are well seen when excavations are being made for the foundation of a building; and they are taught something about the work of glaciers in the past and present. After seeing the glacial markings in one location, one of the boys drew my attention to them another day in a different place, showing that his powers of observation and memory were at work. These glacial remains, together with the boreal character of the fossils in the clay, demonstrate to the boys that the climate during the age of the Flood was colder than at present, and that the higher grounds at least, if not also during part of the time the lower grounds as well, were covered with a glacial ice-sheet or ice-sheets, such as at present occur only in higher latitudes or higher elevations. From which they infer that during the early Pleistocene age the land, far from being flooded, was very much more elevated than at present, though there may have been other causes of refrigeration operating. The striæ of Ottawa prove that the Chelsea hills at least were the seat of a glacier which moved in a southerly direction over the beautiful site of the future capital of Canada.

The boys' attention is next directed to quarries, cliffs and faults, where they may see the solid limestones, sandstones and shales that underlie the marls, sands and clays. They are taught to distinguish the various formations partly by their general appearance, but chiefly by the character of their fossils, specimens of which are collected by each pupil.

With their energy and suggestibility, their collecting instinct, and their spirit of emulation, boys make excellent collectors of natural history objects and their sharp eyes make many an interesting find. To extract fossils from the hard rock requires considerable care, patience, and determination, but I have found these little boys steadily to develop the necessary interest and will-power. To hammer away for ten minutes, or in some instances much longer, striving to undermine a coveted specimen, occasionally having to desist for a time with a rock-splinter in the eye, and then, after all one's efforts, crack the fossil in two at last is very discouraging; but I have often reason to admire the spirit displayed by the boys in such disappointments. When the time comes to go home the majority are always for staying longer, for staying on, indeed, indefinitely. After an outing longer and more arduous than usual, one of the youngest of the boys next day caught cold, due possibly in part to over-fatigue. But the plucky little fellow said "Well, if I am sick, I had a good time anyway." In exceptional cases these outings have sometimes proved too tiring, but as a rule they have had a beneficial effect upon the health and spirits of the boys, as the parents have often testified. In some cases the physical benefit has been very marked.

The training in observation that the boys receive in these outings is evidenced by the many curious things the boys find and bring me other than those we are specially in search of. They see the larva of the caddis-fly in the water in its garment of tiny sticks: the mud nest of a wasp pasted against the rock; the woolly plant-lice in their pretty fluffy white dresses, clothing the branches of a tree, while many bees hover around; the cone-like gall on the willow; a dead mole on the road; all of which may form and suggest matter for interesting investigation.

To return to our fossiliferous rocks, the pupils readily gather that those stratified rocks are the sediment of an ocean much older than "the Flood," a sediment which has been hardened by pressure and other causes. With the aid of a colored chart of the crust of the earth, the boys are made acquainted with the wonderful succession of geological ages, with their evolving organic forms. Comparing this chart with Dr. Ami's synoptic table of the geological formations about Ottawa, they see that there is a great gap in the record here. As there are no sedimentary rocks of more recent date than the Silurian within several hundred miles of Ottawa, and no trace of the previous existence of such rocks hereabouts, I am able to elicit from the boys by careful questioning that it is probable that no further sedimentary rocks were formed here and that consequently this part of the continent was dry land during the ages that intervened between the Silurian and the Pleistocene. The fossils found in these ancient Cambro-Silurian formations are all seen to be of invertebrate forms of life, — corals, star-fish, worms, crustaceans, mollusks, — showing how primitive life was in that remote age.

Finally, beneath these sedimentary rocks lie the metamorphic rocks of the oldest geological time, known as the Archaean. The city of Ottawa lies not far south of the oldest part of the American continent — namely, the great Laurentian ridge. In their visits, hammer in hand, to various mines in this rugged district, as well as to outcrops in other localities, and to erratics near at hand, the boys are able to make collections of the characteristic rocks and minerals. And from these eruptive rocks, as well as from the folds and faults in the limestones, they learn something of the terrific forces at work in the bowels of the earth. The boys (who range from eight to fourteen years of age) are, I have found, not too young to take a keen and intelligent interest in the matters treated. The parent of one of them — a lad of ten — told me of a lecture in geology his boy had given him in form; a lecture, he said, that contained good information well expressed. All at least gain health, and an attitude of mind that will forever prevent their becoming mere book-learners, while at the same time their interest in books is rendered more keen, intelligent and profitable: something that mere text-book instruction will never do for children. The boys show their interest in books by using the school library freely, by bringing me books from home on the various subjects treated, and by getting their parents to buy them works on animals, shells, minerals, aquaria.

While it is attempted to cover the whole ground each fall, a part is selected for thorough work. One year it will be recent shells; another, the fossils of the Flood; another, the ancient fossils of the rocks; and another year, rocks and minerals. The views which illustrate this article were all taken this fall (1903). Needless to say, we make constant use of the Geological Museum, which, through the unfailing courtesy of its officers, is a very great help to us.

To read or simply to be told facts and conclusions is one thing; to acquire them in the active, practical way above suggested is another and vastly different thing. The former method has little educational value; the latter must have the highest educational value in the hands of a teacher of tact, resource and reverence — one who, in attempting to decipher with the children the great stone book, has still in mind the words and feelings of the psalmist when he exclaims:

> "How great are thy works, O Lord!
> Thy thoughts are very deep."

For religion is not the denominational thing — the thing of doctrines — that some would still have us narrowly believe. The hope and tendency of the age is quite contrary to such a conception. Neither is religion dependent upon external authority, but upon the individual consciousness. It is a human instinct. The religious spirit is therefore not inconsistent with the scientific spirit, but complementary thereto; and both have their place in every healthful, well-ordered school, as in every sane and well-ordered mind.

As a change from the work of gathering specimens and facts, the boys are sometimes allowed to build bonfires on the shore of river or lake, or to dam streams, or to play in the woods. I shall describe a scouting game which they are very fond of and which we have adapted from the soldiers' game of "spider and fly" recommended by General Baden-Powell in his little book entitled "Aids to Scouting." We play the game in several ways. The boys divide into two bands, one of which, the patrol, is given fifteen minutes or so to hide away somewhere in the woods. Then the other band divides up into parties of two or three or single scouts and set out to find the whereabouts of the patrol. As the scouts approach the patrol, this body must spy them before they are themselves seen; for to be seen is to be captured or killed. It is only necessary to mention the name of the one seen to effect his capture. Much circumspection and alertness are therefore essential to success at this game. Another way is for the two bands to start, upon a signal, from opposite sides of a wood to reach their opponents' fence or bounds without being seen, for to be seen, again, is to fail and go to the prison-tree. The band getting the most through unobserved wins. Still another way is to post one or two sentries in the middle of the wood, whom the others must pass unseen in going from one side of the wood to the other. Even with regard to merely intellectual capacities, such as observation and judgment, patience and persistence, caution, enterprise and decision, and leaving quite out of account the health and joy of living that should and might always accompany intellectual exertion, I confidently leave it to the reader to judge whether some of the time now almost exclusively given up to greenhouse, bookish instruction might not be well spent even in playing a game.

[Reprinted from THE POPULAR SCIENCE MONTHLY, December, 1905.]

THE STUDY OF LOCALITY.

BY CEPHAS GUILLET, PH.D.,

TORONTO, CANADA.

A SIMPLE statement of what can be done and has been done with children is attempted in this article by one who for five years maintained a school in Ottawa for boys, limited in number to twenty and ranging in age from eight to fourteen years.

The afternoon work of this school was conditioned by the season. In the fall, the topography and physiography and the geological history of the city and surrounding country were studied The crust of the earth was examined in outcrops, mines, quarries and excavations, and collections made of soils, shells, fossils and animals for museum, vivarium and aquarium.*

In the winter when animate nature is in a state of torpidity and the earth covered with a mantle of snow, the conditions are less favorable for outdoor study of nature. As nature is asleep, we study her asleep. The forest in particular is a convenient and interesting object of winter study. We observed the general appearance of the tree-skeletons, striving to fix in our minds by memory-drawing the characteristic shapes of the various deciduous trees. We examined the bark of the trunk, the character of the wood (making collections of various woods), the size, form, color, texture, taste and smell of the twigs and buds, and the number and arrangement of the buds. The character of the terminal twigs is an excellent means of distinguishing our trees and shrubs. The various contrivances by which the buds protect themselves are of great interest. The buds, being kept in water, open out, showing how ready they are to cast off their winter clothes when the moisture and warmth of spring shall come.

Approaching Christmas reminded us of the evergreens, which we learned to distinguish, the boys decorating their desks with them. In this connection, I shall describe a typical winter outing. A few days before school closed for the winter holidays, we went to a rugged, swampy brush in search of evergreens, each boy being assigned a particular kind to be responsible for, while all were on the lookout for the rarest in the neighborhood, namely, ground hemlock or American yew. Joyously shouting defiance to the frost king, they trudged over the ridges, plunged down into the gullies, and ran across the tiny ponds. Skirting one of these, they at last found the ground hemlock nestling at the foot of the taller balsam and spruce. Then one of the boys made the merry discovery of the orange berries of the climbing bittersweet shining brilliantly against the bright green of a tall spruce, which it clasped in its tight winding embrace to the very top, while hanging its beautiful clusters down in rich and graceful festoons. At once there was a clambering and a pulling till we had added these gay wreaths to our varied evergreens. Such an outing puts iron into the blood and glad memories into the heart.

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* For a full account of the fall work in nature study, see 'A Glimpse at a Nature School,' in *The Pedagogical Seminary* for March, 1904.

One of our favorite haunts was a piece of bush called Beechwood. Last winter we undertook to make a valuation survey of it on snowshoes. We first marked off a strip by tramping from one end of the woods to the other in Indian file. Then we counted all the trees in that strip, but recorded the measurement only of those of a circumference, breast high, of 36 inches or more. Two boys were assigned to each of the principal trees, one of them using the tape while the other kept tally. In the case of the boys in the illustration, it is evident that two of them are measuring one of the large beeches. In this way, we covered the whole woods in four afternoons, and found it to contain 670 trees, of which 270, or 40 per cent., were at least three feet around. All the trees but 90 and all the large trees but 30 were maple, beech and basswood, there being as many large maples as large beeches and basswoods together. The other trees present we found to be elm of two species (American elm and slippery elm), ironwood, yellow birch, hemlock, butternut and white ash.

At the school, we worked out the diameters of the trees whose circumference we had recorded, and then with the aid of lumbermen's tables found the total contents in board feet of the three most numerous species. Counting the lumber as worth $12 a thousand, we soon found out the value of the standing timber of our little woods to be about $800. Meanwhile, with compass and pencil in hand we had ascertained the shape and size of the wood, made a chart of it and estimated it to contain about eight acres.

In the spring, we studied the character of the underbrush and of the soil cover and indicated with proper surveyor's signs the large wooded portion, the two small open grassy corners, the marshy ground, the hill and the paths. Scattered through the wooded part, we placed signs for the principal trees, which signs we had invented ourselves from our observation of the character of the trees. The basswood, for example, we found most numerous in the lower parts, the butternut on the ridges. The ironwoods we noticed to be small but thrifty, shade not being so detrimental to these weeds of the forest as to many other species. At the close of the school year, a little lad of eleven summers had the bright idea of presenting me with an enlarged chart of our wood, done neatly in ink. Here surely is an example of self activity.

Early last April, we spent two mornings in the woods sugar-making. Having obtained permission to tap twenty maples in Beechwood, we bought the outfit and went to work. The first morning we tapped the trees, the boys being taught how to select the best trees and how best to tap them. The reasons for each step were elicited or suggested, science and practise going hand in hand. It was great fun for the boys to watch the sap dropping into the cans, and to see whose cans filled first—proving their owners to have made the best choice of trees or managed the tapping best.

A couple of days later, having on hand a couple of barrels of sap or its product in syrup, we went to the woods to sugar off. First we made taffy by pouring the thick syrup on the snow. Then we boiled the rest down into sugar to take home. The boys in the illustration are enjoying the fruits of their labors in the shape of taffy.

GEOLOGIZING ON PINE ISLAND.

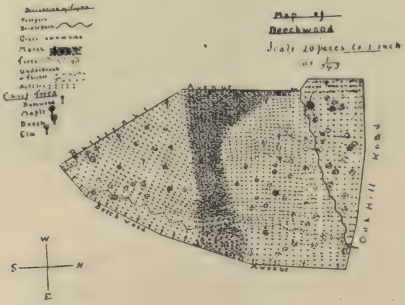
After each of these occupations of surveying and sugar-making, which I have described, and after considerable discussion of the same, the boys wrote compositions on 'Beechwood' or 'A Valuation Survey of Beechwood' and on 'The Maple' or 'Sugar-making.' A boy can write to some purpose after such an experience.

Throughout the spring the study of reviving nature was a never-failing source of delight. The boys took the keenest interest in the return of the birds, the unfolding of leaf and flower, the awakening of frog and snake, squirrel, snail, butterfly and humble-bee. We set up our aquaria and vivaria afresh. We observed the birds in their busy occupations of feeding and nesting. We sketched them in their characteristic attitudes; and learned to distinguish their varied notes and songs. We looked eagerly for the first flowers of spring, the gay hepaticas and sweet Mayflowers or trailing arbutus, and we observed and recorded, until school closed, the lovely procession of the flowering plants. One year we observed the blooming of about two hundred of our native plants of wood, swamp and field. In this way the boys gained some conception of the wealth and variety of the Ottawa flora. We also made a special study of some one family throughout the year. I inserted glass tubes in the desks, and in these the boys were able to keep flowers fresh and beautiful. The boys also drew and painted the plants and made ornamental designs from them.*

During the spring, also, the boys went to the woods and took home trees or shrubs or flowering herbs or ferns, according to their choice, and planted them in their gardens. Just before winter set in, the boys took home herbs from the woods to have the pleasure of a bit of spring in their homes in the middle of winter. In this way we induced hepaticas and spring beauties to bloom at Christmas time, and sweet cicely a couple of months later, when the plants in the woods

THE NATURAL HISTORY OF HEMLOCK LAKE.

A VALUATION SURVEY OF BEECHWOOD.



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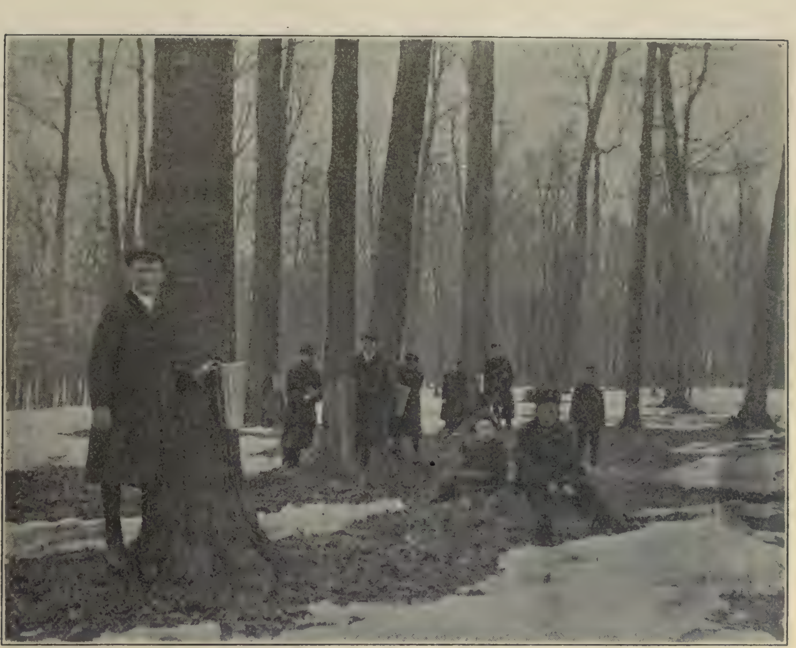
* For an account of the manual work of the school see my article on 'Manual Training' in *Acta Victoriana* for December, 1904.



TAPPING THE MAPLES.

SUGARING OFF.

were asleep beneath a garment of snow and ice three feet thick, as we found by actual measurement.

Hitherto I have been speaking of the study of natural history. I shall now speak of the way we studied culture history: the history of man, his struggles and progress.

As the reader will have gathered, the study of nature in this school was by direct observation. Books were used, to be sure. The school library contained many books about nature, and the readers used were Wood's 'Natural History Readers.' But the books were not the center of the study; they were merely accessory.

As with natural history, so with culture history. We began by observation. To get a large view of their native place, some six outings were spent in compassing the city on foot. Practical elementary lessons in surveying and mapping to scale were given, beginning with the schoolroom. Then a map was made of the city and its environs, and the course followed in the walks indicated, as well as the topography and the important buildings and public works. Visits were paid, mostly in the winter, to various institutions: to Parliament and City Hall and Market; to the shops of the jeweler, furrier, picture dealer, florist and maker of musical instruments; to the various factories and offices to see men wrestling with resistant matter in its various forms of wood, tin, copper, iron, stone; the lumberman, the joiner, the turner, the carver, the stone molder, the mason, the bridge-builder, the diver, the blacksmith, the printer, the bookbinder. We also attended the Ottawa Valley ploughing match just before winter set in, and visited the Experimental Farm at all seasons.

Meanwhile, the history of our city and district from the days of the sturdy backwoodsman to the present was unfolded and maps were made of the county and district. The industries of the locality were studied as conditioned by its peculiar resources in soil, timber, minerals and water-power. Then the early history of the various provinces and of the Atlantic states was narrated. The gist was given (with occasional reading of the more interesting parts) of many works relating to the discovery, exploration and settlement of the various parts of the American continent by the races of Europe. A map was drawn and so marked and colored as to give a bird's-eye picture of the course of discovery and settlement. In another map the native districts of the Indian aborigines were indicated, and something was told of Indian character and legend. Here again the school library was a valuable adjunct in the work, and sometimes the boys brought from their homes books bearing upon the subject in hand.

The parents have freely expressed their appreciation of the methods of the school.

I have tried to describe the value of this natural education, yet I have scarcely touched upon one aspect—perhaps most important of all but too subtle to be pictured either in words or in illustrations. I mean the sweet, unconscious influences of nature and of one's native environment. By taking care that the child's associations with home are rich and full, we provide for the man an inexhaustible source of inspiration.

The reader will have observed that all that I have spoken of so far is really history—the history of nature and of man; and he will have seen how impossible it is entirely to separate these two things in any natural treatment of them. This is because they are not so much two separate things as two aspects of the same thing. Does not the reader see the application of this truth to education? Does it not suggest to him the thought that in taking his children away from nature, away from their natural environment, and shutting them up all day in a schoolroom, chained to desks and books, he is doing violence to all that makes boyhood precious—to its naïveté, to its love of all out-doors, to its instinctive craving for activity, and he is depriving it of the most natural means of its own development?

STUDYING THE NATURAL HISTORY OF BEECHWOOD.

I wish to guard against a possible misapprehension. I am not laying down a school course for teachers. My school was situated in Ottawa, and the choice of culture material was governed largely by that fact. If I were to teach in Halifax, or Toronto, or Calgary, or Vancouver, I should deem it my first duty to study the conditions existing there. For I hold that the teacher will find in the locality, in the environment in which he lives and in which his pupils live, the most appropriate and the most educative material of instruction, far exceeding in value that found in any text-book or in all the text-books.

To the teacher, therefore, this article is purely suggestive. It is for the trained teacher who possesses independence and initiative to work out his own course. His course should grow with his growth and with his increasing knowledge of his pupils and of his environmental conditions. It should be the teacher's task to locate his locality in its relationship to the rest of the country, geologically, geographically, meteorologically, botanically, zoologically, historically, in politics, in art, in literature, in industry, in all its conditions and endeavors, showing the place it has taken and the place it is destined to take in the building up of the national spirit and character.

On the Boom.

Manual Training

(Reprint from Acta Victoriana, December, 1904.)

BY CEPHAS GUILLET, B.A., PH.D.

ANY thorough course in manual training must involve a study both of nature and of human history. It cannot ignore the past and it must draw new inspiration from nature, the perennial source of beauty. The goal never to be lost sight of is the marriage of beauty and utility.

In my own school, in which I had an opportunity of applying, unhampered by outside interference, the best methods I could discover or devise, I at first adopted a modification of the sloyd system. I taught my boys to use the knife and the tools of the carpenter in making various simple objects connected with their interests; as a marble-stick and other playthings, a pen-holder, a moth-drier, a bird-house, a set of shelves for specimens, and the like, most of this work fitting in well with their work in nature study.* Realizing, however, that this, while good as far as it went, was very elementary work of limited educational value, I supplemented it with work involving higher faculties and appealing to more permanent interests. This was in large part the method of J. Liberty Tadd, as outlined in his "New Methods in Education."

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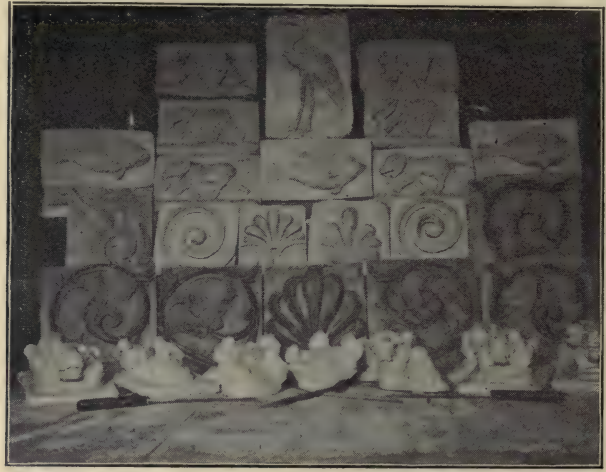
* For an account of the work of my school in the study of their environment, see *The Pedagogical Seminary* for March, 1904, "A Glimpse at a Nature School."

I shall briefly describe a year's work of my school in this higher manual training. First we worked with the traditional units of design, as they have been created by the finest artistic minds—the scroll and anthemion, the shell, the leaf and bud and rosette. We learned to draw these with facility with both hands and then studied how to arrange them in beautiful patterns.

The illustration on the first page ~~193~~ shows the designs invented during the Fall term by nine boys from eight to fourteen years of age, except three of the designs which are by myself. They are variously executed in crayon, common ink, India ink and water colors. The boys invented from three to six patterns each, mainly head pieces, centre pieces and borders.



The boys were also taught to model both conventional and natural forms in clay. Clay has been used by man from time immemorial as a means of expression, and nothing is so suitable for the expression of the child's artistic conceptions as this wonderfully plastic material. The illustration on this page ~~194~~ shows clay models made by nine boys in the winter term.

Frequently the boys were taken to the Zoological Museum and trained to draw some of the animals from memory. One was first allowed to scrutinize the animal selected until he thought he had a good mental image of it. He then went into another room and drew it. This proved to be an excellent means of training the powers of observation and memory. The same animal form was sometimes also modelled as well as drawn from memory at the school the next day or several days later. It thus became fixed in the mind.

In March we sometimes took advantage of the thaws to model outdoors in snow from memory the animal forms we had learned to draw and model in clay. On this page ~~195~~ are several groups of boys modelling in snow on Cartier Square. I one day took them to Parliament Hill and had them model in snow a large lion's head on each side of the great steps leading up to the Parliament Buildings.

As soon as a boy can model a good scroll he is taught to carve it in quartered oak (see illustration page 4 ~~196~~). He is then encouraged to carve an original design for some article of furniture. As a means of at once arousing and giving a beautiful direction to energy, carving in the tough oak is a splendid exercise, both physical and intellectual. It gives grip and grasp.

In the illustration on page 5 ~~197~~ are the designs of carving for furniture, many of them (nearly all the more elaborate) original, carved in oak and other hard woods during five months by nine boys. There are panels for a coffer, a mirror-frame, the top of a plant stand, the ends of table book-racks, and several picture and photo frames. Some of the work there was not time to finish, but the pupils are both able and willing to finish it without further oversight. Such work gives boys confidence in themselves, the true confidence that comes from knowing that one can do things worth doing. All too much time is spent by our youth in mere sport.

In the spring, in connection with the work in nature study, the boys are taught to draw and paint our native plants. I have found that this work reveals to them beauty they had never observed before. "Why I never knew the wild ginger was such a beautiful flower!" was the exclamation of one of the boys after studying it in this way; and the others echoed his opinion. In the illustration on page ~~198~~ six they are painting plants on the Gatineau River at the beautiful Chelsea Rapids.

Several of the plants are conventionalized and used in designs. The boys spent the last day of school at Rockliffe, by the Ottawa River (where they may be seen in the illustration on page seven ~~199~~), painting designs from the beautiful wild ginger and the graceful little twin flower vine.

The manual training I have tried to picture develops something more than mechanical accuracy. It develops taste and inventiveness, qualities that are of the highest importance to society and which are yet hardly thought of in our ordinary systems of education; for these inculcate both the conservative and the critical attitude of mind, but rarely the constructive. What would not our manufacturers give for young men who had been trained in this way for a number of years to turn out work of high quality and finish? If we are to compete with the nations of the world as a manufacturing country, our educational systems will have to be revised.

Again, in all the exercises I have described of drawing, modelling and carving (and, indeed, of writing also), the pupils are trained to use both hands with equal facility. Consider the advantage that a race trained to be two-handed and symmetrically developed in brain and body would have in all the arts both of peace and war.

But these more or less utilitarian results are not the only ones. The boys' eyes are opened to beauty of form and color wherever it is to be found in nature and art, as their parents have testified. Their minds are enriched, their experience broadened, their higher interests aroused, their capacity for happiness enhanced. The child can be truly educated not through books alone, nor even through nature study by mere observation and talk, but through the incorporation of the environment by the participation of the whole organism of the child in its apprehension and appreciation.

The utilitarian test, however, is not to be despised. For, in the last analysis the products of a people, whether the immediate work of artists or of artisans, or indeed of any class of workers, are the resultant, not alone of the skill and frugality, but also of the wisdom, the culture and the character of that people. And in this lies our truest ground for optimism in the struggle of races. On these terms the honest man will only welcome the competition of other races, whether they be white or yellow.

A great deal is being said these days about the importance of manual training, but in general all too narrow an idea prevails of what manual training is or might be, and often the nature and needs of the child, body and mind, are quite overlooked. The strong point of the sloyd system is its appeal to the simple interests of the child, in that it has him make a finished object in which he takes a real interest. Its weak points are its narrow interpretation of the child's interests, and its insistence upon a logical system based on a study of tools, rather than upon a psychological system based upon a study of the child. I may illustrate the latter point by pointing to the first object that the child is taught to make. It is a tiny wedge about three inches long and about an inch wide, and one-quarter of an inch thick at the thick end. This tiny object is to be made by a knife in the child's clumsy hands. It recalls the mistakes of the kindergartners. Now it is a well-known fact of child growth, as of racial growth, that the large muscles of trunk and limbs develop first, the finer muscles of the hand last. The child, therefore, should at first be set to make large objects roughly with such tools as the saw and the hammer.

The sloyd system's narrow interpretation of the child's interests, to which reference is made above, is seen in its exclusion of the instinct for beauty, for ornamentation, an instinct possessed by the child in common with primitive man and his present representative, the savage. This instinct Mr. Tadd's system exploits in a very beautiful, but possibly too highly developed way.

The Japanese exercise their decorative skill upon the common objects of daily use. The Persians used to do the same; and to this day the Persian artisans make their own designs. Every true manual training teacher will strive to encourage and guide his pupils in likewise ornamenting with ever increasing art the things they like to make.

The excellence of Mr. Tadd's system lies in its insistence upon freehand drawing and designing as the base and centre of the work.

The ability to design is the key to all the minor arts, to clay-modelling wood-carving, the work of the goldsmith and silversmith, embroidery, *repoussé* work, and many other beautiful arts to which our Canadian youth are unfortunately strangers. Here is a field well worth the attention of our manual training teachers and our technical schools.

It is not another system we want; it is *men.* There is too much of "system" in all our educational effort, and too little of man, of the live, enthusiastic, courageous, original teacher. For all true educational work, whether manual training, or nature study, or history, or any other culture material employed to inform and develop the *body-soul* of the growing child, we need not departmental regulations or curricula, but men—men of insight and enthusiasm, men of culture and special training. Here we touch the weak spot in our public system of education—the dearth of men thoroughly trained for their work. For all other skilled work based on science a long and severe special training is essential. Of the physician, dentist, lawyer, minister, engineer, years of direct preparation for their work is required, while we in Canada require of the teachers only a few months' crude training. What we need is a College of Educators, or, rather, several such, in affiliation with our universities. Until we have these and require our teachers to attend them, grading them and paying them according to the number of successful years there spent, teaching will not be a profession and the public will, in the main, continue to be badly served by those who should be the most important and valued servants of the state.

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